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TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

SOUTH AUSTRALIAN MUSEUM ADELAIDE

(INCORPORATED)

VOL. LV.

[WITH EIGHT PLATES, AND THIRTY FIGURES IN THE TEXT.]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.
ASSISTED BY ARTHUR M. LEA, F.E.S.

[*Each Author is responsible for the soundness of the opinions given, and for the accuracy of the statements made in his paper.*]

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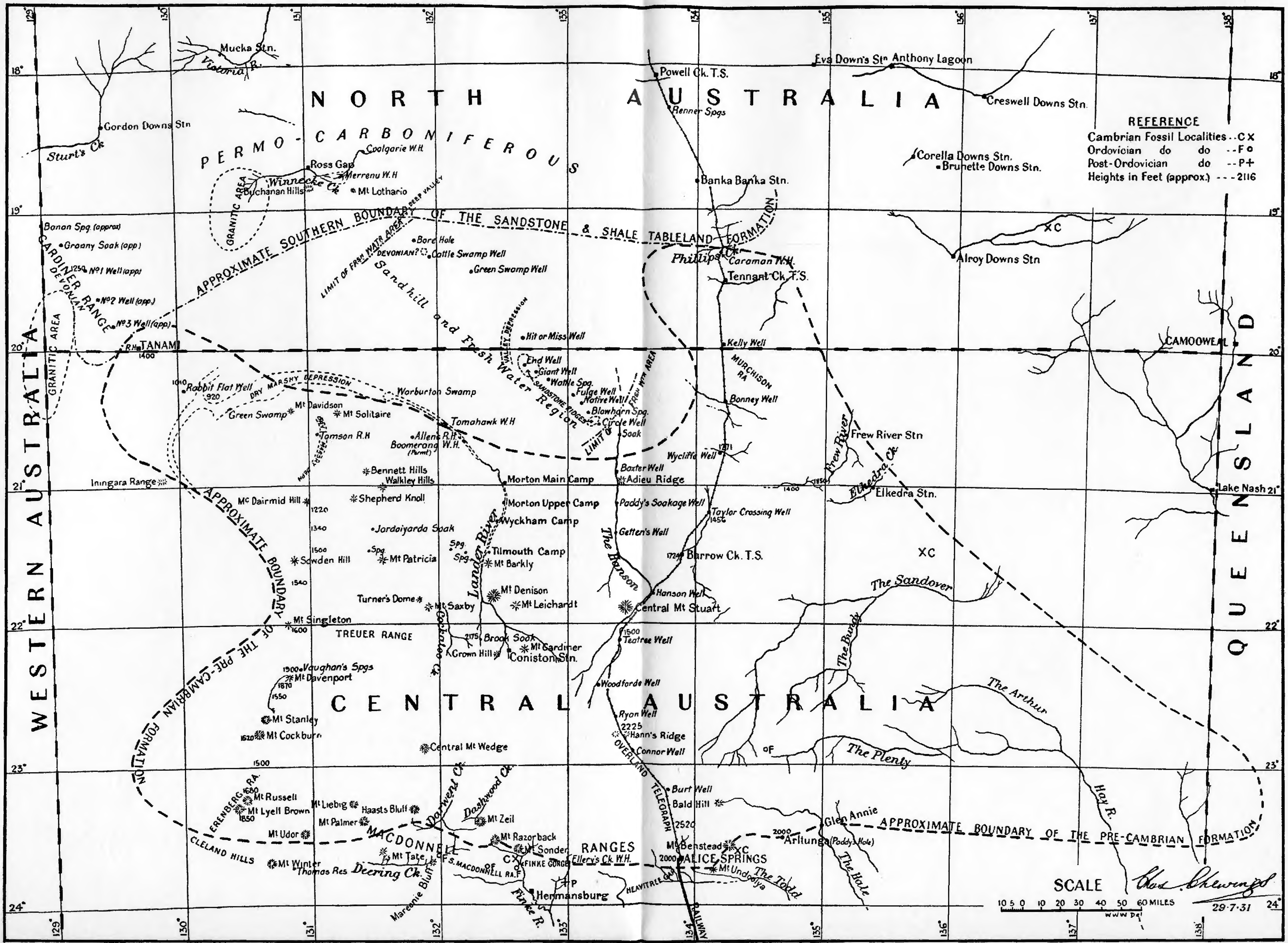

THE PRE-CAMBRIAN PLATEAU IN CENTRAL AUSTRALIA AND IMPINGENT SEDIMENTARY FORMATIONS.

Transactions

of

The Royal Society of South Australia (Incorporated)

VOL. LV.

A DELINEATION OF THE PRE-CAMBRIAN PLATEAU IN CENTRAL AND NORTH AUSTRALIA, WITH NOTES ON THE IMPINGENT SEDIMENTARY FORMATIONS.

By CHARLES CHEWINGS, PH.D., F.G.S.

[Read April 9, 1931.]

WITH MAP.

THE ARUNTA PRE-CAMBRIAN COMPLEX.

On a former occasion the writer made reference to the Pre-Cambrian rocks of Central Australia, and the sediments thereon.(1) He now proposes to supplement those observations with a plan of the area, showing the actual contact of the Pre-Cambrians with any of the well-established sedimentaries, where known, and the "approximate" margins where the boundaries are still undefined. Many years must elapse before the true boundaries, in places, can be laid down. By reference to the map, it will be apparent that the area under consideration, and which contains some 85,000 square miles, forms the main central "boss," "shield" or plateau, or high-level region of the continent. All the major watercourses take their rise upon it. On the western and northern sides of the plateau the "fall" is sometimes not readily apparent from the short creeks, because any flood-waters are immediately swallowed up in the ubiquitous sea of sand, but the few barometrical readings available, which are on the map, will give some idea of the inclines and declines, and the heights above sea level. The height of the hills above the general level of the country is not given, but it may be mentioned that only a few mountains in Central Australia exceed two thousand feet above the surrounding plains. The elevation of the plateau is not great either, the highest portion, *viz.*, between Central Mount Wedge and Bald Hill, averages only about two thousand feet above sea level.

As pointed out in the paper above referred to, the heart, or central core of the original McDonnell Range ran east-west along, or very near to, the 23° S.L. From where the Hay River turns south (on the east) to Mount Udor (on the west) is still the main north-south water-parting—a stretch of over four hundred miles. One off-shoot from the main chain of mountains ran north-west in the direction of Tanami, and another ran north-westerly to beyond Tennant Creek. Between the extremities of these two lines lies the "Lander Depression," of which interesting feature a full description will be found in the Geographical Journal, October number, 1930, pp. 316-338. *Vide* also, *op. cit.*, p. 80.

(1) Trans. Roy. Soc. S. Austr., vol. lii., 1928, pp. 68-76.

SEDIMENTARIES IMPINGING ON THE COMPLEX.

Some of the rock-formations that impinge upon, even if they do not actually contact with, the Pre-Cambrians of the plateau are both interesting and important in the geological record—the unravelling of which record is the principal object of this thesis. On the south margin, as is now well known to some, there runs an east-west series of sedimentary formations, all compressed together and uptilted in such a way that even skilled observers have regarded the whole as belonging to one system. By degrees the several formations are being made out, the latest contribution to the subject being a paper by Messrs. Mawson and Madigan, entitled the Pre-Ordovician Rocks of the McDonnell Ranges.(2) This paper deals with the "inside" system—the one that contacts with the Pre-Cambrians. The authors contend that between the Ordovician beds and the Pre-Cambrian rocks there runs a great series of quartzites, slates, and limestones, that are "older" than, and unconformable to, the Ordovician Series. The writer welcomes this support to his own reading.(3) The lowest beds of their Pre-Ordovician Series are quartzites, and it is these that, dipping steep to the south, contact with the Pre-Cambrians over a stretch of two hundred miles, almost continuously. The contacting quartzite is overlain by limestones containing Cryptozoön and other fossils, of probably Cambrian age. This formation is succeeded at the Finke (River) Gorge, and elsewhere, by fossiliferous quartzite and limestone beds of Ordovician age. These, in turn, are overlain by the remarkable Post-Ordovician conglomeratic sandstone series, which contain "derived" Ordovician fossils—the three formations, placed as they are, are a very interesting study, and the person who can determine the age of the conglomerate beds will assist the geological record greatly.

As Messrs. Mawson and Madigan's paper was presented in London, it may be of interest here to observe that they therein suggest aboriginal names for the more important groups. The writer considers the suggestion a useful and happy one, but would slightly alter the spelling of some of the names suggested by them to the following, and also add No. 4 to the list:—

1. Arunta Complex = the Pre-Cambrians.

2A. Pertaknurra Series = the inner (lower) quartzites, slates, and limestones (7,500 feet thick) = Pre-Ordovician or Cambrian (?).

2B. Pertaoorta Series = quartzites, slates, limestones (2,850 feet thick) = Pre-Ordovician or Cambrian (?).

3. Pertakooka = Larapintine in part of Tate and Watt = Ordovician.

4. Pertnjara = the Post-Ordovician Conglomeratic-Sandstone Formation.

NOTE.—1. = the name of the local tribe; 2A. = the big range; 2B. = limestone; 3. = small range; 4. = many stones (range).

At the head of the Finke and westward to where the ranges fall off, the northern, and higher, portion—which is known on the spot as the McDonnell Ranges—embraces, in a general way, Nos. 1 and 2A; and the "South" McDonnell, Nos. 2B, 3 and 4. Where the South McDonnell ends, *viz.*, a short distance west of Mount Tate, the Cambrians have either been completely eroded, or faulted out of sight, but south of Mount Tate the Ordovician sandstones of Gardiner's Range, with thin bands of fossiliferous limestone interlarded, still run on westward, in the form of an anticlinal fold. The strike of the anticline is a few degrees north of west, in which direction it becomes covered with sand, but soon rises again and forms the Cleland Hills and other sandstone ridges farther on in the same direction. Lithologically these Ordovician sandstones bear little or no resemblance to the Cambrians, and are far less disturbed than the older series. These latter being absent along that portion of the line lying north of Mount Winter and

(2) Abstr. Proc. Geo. Soc. of London, No. 1,209, 1930, p. 56.

(3) Trans. Roy. Soc. S. Austr., vol. lii., 1928, pp. 63-68 and 76-78.

Thomas Reservoir, and south of the Ehrenberg Ranges, doubtless the contact is with Ordovician rocks, and apparently identical conditions continue around to the west of Mounts Lyell Brown, and Cockburn.

One may here remark that the McDonnell Ranges, as a bold feature, ends in the prominent peak of Mount Liebig, but the Pre-Cambrians extend far to the west of that mount, to beyond the Ehrenberg Ranges; and they apparently extend westward an equal distance in the western end of the Treuer Range. As far north as the 22°, or perhaps even to the 21° S.L., the writer thinks Ordovician rocks may form the contact with the Cambrians, but wind-blown sand appears to cover everything along that stretch. From Treuer Range the elevation decreases, going north. Somewhere hereabout two other rock formations seem likely to put in an appearance, for they are in evidence farther north, and also farther west. One will be referred to hereafter as "Winnecke Creek Tableland Formation" (which is of Permo-Carboniferous age). The other is Devonian. The former, according to W. H. B. Talbot,[4] who mapped the area, extends from Gardiner's Range, and Tanami, to Hall's Creek, and from there south-westerly along the Canning Track to 23° S.L. Over the whole of that area this formation appears to have suffered much from erosion, but very little from earth movements, since it was laid down. With the exception of island-like areas more elevated than that on which it occurs, the formation apparently covered the whole area between Treuer Range and Derby. This fact, coupled with another, *viz.*, that *so far as is at present known it was the last formation to be deposited* on the north and north-western slopes of the plateau, renders it of great interest. The strata are composed of conglomerate, grit, shale, and sandstone, often highly ferruginous, and coloured chocolate brown on exposed faces. No limestone beds were observed in the strata along the Canning Track. A considerable extension of this formation, in an eastward direction from Tanami, beyond Talbot's boundaries will be referred to later on. In the Tanami (Gardiner's Range) district, both Permo-Carboniferous and Devonian appear to contact with the Pre-Cambrian.

Along the Canning Track, where the Permo-Carboniferous formation ends, *viz.*, near the No. 26 well (which lies a little north of 23° S.L.), rocks of Devonian age occur, and the area between No. 26 well and 25°-30° S.L. Talbot has mapped as Devonian—with the *eastern boundary* of that formation still undefined. The strata are there composed of sandstones, quartzites, shales, grits and conglomerates. Exposures, all over the area seen by Talbot, showed that the formation (unlike the Permo-Carboniferous beds) had undergone considerable disturbance, as well as vast erosion. The dips varied greatly, up to 65°. The strike varied greatly also. Faults also were numerous in the formation which, in that district, reposes on granite and metamorphic rocks.

Judging from Talbot's determinations, it seems probable that Devonian rocks at one time occupied the area between No. 26 well and Hall's Creek, and eastward to Tanami, and probably far beyond that. The Albert Edward Range (near Flora Valley Station), in the Kimberley District, is composed of rocks of Devonian age. In that range, according to Talbot, the Devonians repose on metamorphic rocks and, in turn, are overlain by the Permo-Carboniferous formation. Gardiner's Range is situated north-west of, and is near to, Tanami. Talbot recognised it as of Devonian age, and mapped it as such, with Permo-Carboniferous rocks overlying to the west and north. He refrained from expressing an opinion on, or even colouring, any part over the border, *i.e.*, in the Northern Territory, but Mr. H. Y. L. Brown's description and map [5] show the Permo-Carboniferous formation to

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(4) W.A. Geolog. Survey. Bulletin, No. 39.

(5) H. Y. L. Brown, Tanami Gold Country. Parlty. Paper, Adelaide, 1909, p. 7, *et seq.*

extend north-easterly to near the Mucka Outstation, on the Victoria River. Mr. Brown, however, did not separate the Devonian from the Carboniferous, and referred to the two as "sandstone, grit, quartzite, and conglomerate of the table-hills and tablelands," and as "Primary rocks." Mr. Allan Davidson, the discoverer of Tanami, also mapped the two formations as one, and set the age down as "Secondary." [6] He shows the formation, which he maps as Secondary, and Talbot as Carboniferous, to extend eastward to the Buchanan Hills but, strange to say! he did not colour the Winnecke Creek exposures at all, although he walked over many scores of miles of the formation (Permo-Carboniferous). It is to Talbot we owe the discovery that both Devonian and Permo-Carboniferous rocks contact with the Pre-Cambrians in the Tanami sector; the latter only, of course, where the former had been completely eroded away prior to the deposition of the latter.

Some Remarkable Devonian (?) Remnants.

And here it seems opportune to mention that, originally the Devonian formation assumed a greater elevation around the great Central Plateau than ever the Permo-Carboniferous did and, consequently, ascended the slopes much farther. Great erosion had taken place over the plateau prior to the laying down of the Devonian formation, and, of course, all other sedimentaries had been removed from areas where it reposes on the Pre-Cambrians. From Davidson's descriptions one cannot doubt that the Pre-Cambrians were covered prior to the Devonian epoch by still older sedimentaries all the way between Tanami and Barrow Creek, along the line he returned by to the telegraph line. Although the principal orographical disturbances may have gone by—and probably they had—it is, nevertheless, certain that the Devonian formation was in existence during the latter stages of the mountain-building period, for everywhere the remnants show unmistakable evidence of, if only slight, uplifting and disturbance. Talbot observed one case where quartz reefs were present in the bedding planes. This was on a partially-eroded anticlinal arch—but, taken as a whole, the Devonian rocks appear to show little, or none, of the ordinary metamorphic characteristics of the oldest sedimentaries; at any rate around the Central Plateau. The formation is seen to be greatly eroded, except in protected areas, or where the component rock happened to be of exceptionally durable character, or where protected by a durable covering. Over large tracts of country the formation, notwithstanding its original massive character, is now represented only by remnants.

The following allocations must be taken as "suggestive" only in an effort to "place" the age of certain well-known remnants occurring in Central Australia. *First:* The writer suggests that the Post-Ordovician Conglomeratic-sandstone formation, of the Finke River,[7] may be of Devonian age. *Second:* Judging from John McDouall Stuart's description, Mounts Denison, Leichardt, and Barkly, of the Lander Creek, [8] may be Devonian. *Third:* Mounts Palmer, Crawford, Peculiar, and Udor, [9] at the western end of the McDonnell Ranges, may be of Devonian age. *Fourth:* Ayer's Rock, Mt. Olga, and Mt. Currie, in the Lake Amadeus Valley. As these three very remarkable remnants have been regarded by some geologists as belonging to some far older rock-formation than the Devonian, it may be advisable to examine the evidence we have to ascertain whether such opinions were justified. To this end, and to make my reasons more easily understood, it seems requisite to postulate that: Two long lines of granitic rocks formed the main orographical features of Central Australia in Early Palaeozoic times. Remnants show that the two lines—they were then high mountain ranges—maintained a rough parallelism to one another. The two lines of

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(6) Allan Davidson, Explorations in Central Australia. Parlty. Paper, Adelaide, No. 27, 1901.

(7), (8), and (9) Trans. Roy. Soc. S. Austr., vol. lii., 1928, pp.: (7) 76-77, (8) 80-81, (9) 78-79.

ranges were separated by a low-lying tract of country, 150 miles across. Both lines ran east-west in the eastern half of their courses, and west-north-west in their western halves. We will call the northern line "The McDonnell Line," and the southern one "The Musgrave-Petermann Line." The earliest sedimentation we have to do with, in this connection, is the one that now is represented by the quartzite cappings of many of the northernmost granite and gneiss hills of the Musgrave-Petermann line. These latter lie south of, but apparently do not approach, the line of conglomerates nearer than 20, or more, miles. As the quartzites dip north, and as the conglomerates stand well out in the Lake Amadeus Valley, the ground on which the conglomerate beds repose, and the intervening space between them and the quartzite cappings, almost for a certainty, is occupied by the up-turned edges of strata that originally formed the flanking beds of the range—in the way the South-McDonnell sedimentaries do today; the dips of the said strata increasing in the underlying beds as they approach the site of the old, but long since denuded, range. (It will be shown later on that the quartzite beds do actually underlie the conglomerate, but exposures are rare in that sandy region.)

Similar quartzite beds overlie, and contact with, the Pre-Cambrians in the McDonnell line. The formation to which they—the quartzite beds—as represented by the cappings—in the Musgrave line belong is covered by younger sedimentaries, or sand all the way to the McDonnell—150 miles. Ordovician strata are very much in evidence over the stretch between the two lines, as the following will show. First we have the Gardiner's Range anticline that lies near to, and south of, the McDonnell. This anticline is fossiliferous. The next (omitting the short anticline near Temple Downs old station) is George Gill's Range anticline. This also contains Ordovician fossils. Then follow on sundry outcrops of, lithologically, identical rocks that occur sporadically in the sandy country between George Gill's Range and Lake Amadeus. These show that the folds follow on, but decrease in intensity the farther away they get from the ranges. Between Lake Amadeus and the conglomerate beds no outcrops have been noted above the sand, but *on* the conglomerate line, *viz.*, to the east of Mt. Olga, there is an outcrop of quartzite that dips north at 55°, and strikes south 75° west. The strata-dip here is to the *north*, and fairly steep, which indicates that the quartzite strata belong to one of the formations that flanked the Musgrave-Petermann line of ranges. Mr. Frank George, in referring to the quartzite outcrops and cappings seen by him in the Mt. Olga area, states: (10) "It again occurs east from the Mt. Olga group of hills, where it has a thickness of about 300 feet, strikes south 75° west, and dips north at an angle of 55°, *and appears to be overlain by the Mount Olga boulder conglomerate beds*, but the line of contact between the two formations being covered with sand their relative positions cannot be definitely ascertained. The conglomerate contains boulders of similar quartzite. Mount Connor, an isolated flat-topped hill to the eastward, is capped by similar quartzite having a thickness of over 300 feet. Mount Olga Range consists of about thirty immense dome-like masses of boulder and pebble conglomerate. The contained boulders are waterworn and smooth, and with the exception of a little quartzite consist wholly of granite and eruptive rocks, the boulders varying in size from 2′ x 1′ x 6″ down to pebbles the size of peas. A rough semblance to stratification is observable in this conglomerate bed; the layers of boulders lie in parallel planes, having a dip westward of from 10° to 15°."

In the Journal of the Horn Scientific Exploration to Central Australia (11) there is a good photograph of some of the hills in the Mt. Olga Range, which

(10) Wells and George, Prospecting Operations, Parlty. Paper, Adelaide, No. 54, 1904, pp. 6-7.
(11) Horn Expedition. Parlty. Paper, Adelaide, No. 19, 1896, p. 28.

shows the bedding planes very clearly and, as stated by Mr. George, are nearly horizontal. It follows therefrom that the conglomerate beds repose unconformably upon a sedimentary formation of greater age. J. A. Watt, a geologist in the Horn Expedition (*op. cit.*) remarks: "Mt. Olga appears to be composed of a coarse conglomerate from top to bottom, which consists, for the most part, of pebbles of granite and other eruptive rocks (*vide* also No. 1 reference, p. 8, for a list of some of the rocks)." W. R. Murray [12] measured the height of Mt. Olga, *viz.*, 1,420 feet above the plain, and states that "some of the pebbles would weigh several hundredweight," and that "the summit appears to be quite inaccessible." Of Mt. Currie he states: "The formation is the same conglomerate as Mt. Olga." The Mt. Currie Range is not so high as the Mt. Olga; it lies a few miles to the north-west of the latter, and is a remnant of the same conglomerate formation.

Before quitting this conglomerate formation—the outcrops of which occur at intervals, in lineal arrangement, for 50 or 60 miles—some reference to Ayer's Rock must be made. It lies 15 miles east of Mt. Olga. Watt states (*op. cit.*) that: "Ayer's Rock is very indurated, and to some extent, *altered arkose sandstone,* decidedly gritty in parts." "The original sedimentary character of it is unmistakable." Smooth, rounded pebbles of quartz and felspar are visible in hand specimens. It has been to some extent altered by metamorphic agencies. It stands about 1,100 feet above the plain. The sides ascend, in places, quite vertically for 500 to 600 feet. A peculiar netted appearance is to be seen in some of the faces, due to the irregular weathering of the rock. A ridging is observable, which probably indicates the direction of foliation planes trending in a N.W. and S.E. direction." George states (*op. cit.*): "Ayer's Rock consists of metamorphic pebble and grit conglomerate. The pebbles are sub-angular, and vary in size from that of an almond to coarse sand. "They consist of felspar and quartz, but chiefly felspar."

A reproduction of a recent photograph of a portion of Ayer's Rock that appeared in *The Register* newspaper, Adelaide, of November 11, 1930, shows the strata in Ayer's Rock to lie near the horizontal.

It is evident that these remnants—Ayer's Rock, Mount Olga and Mount Currie—represent quite a massive and important formation. The conglomerate evidently is the detrital matter from an elevated and vast area of plutonic rocks that, at the time the conglomerate beds were formed, stood thousands of feet higher than the top of Mount Olga. The mountainous area had, even at that early period, reached a stage in its denudation when the Pre-Cambrians supplied the greater proportion of the conglomerate, in the form of boulders of granite and other deep-seated rocks. It was a very old range when the conglomerate beds were laid down, and the end of the great earth movements was approaching. This is evident from the nearly horizontal disposition of the Mount Olga conglomerate strata; and the absence of extensive jointing, uptilting and fractures in Ayer's Rock points in the same direction. Much jointing and fracturing is a feature of all Pre-Ordovician rocks in Central Australia. The writer regards Watt's suggestion, *viz.*, that the "ridging" which probably indicates the direction of foliation planes in Ayer's Rock as untenable. The disposition of the underlying sedimentaries, and also the bedding planes in the Mount Olga Range and Ayer's Rock, nullify the possibility of horizontal pressure of such magnitude, so late in the day—in the tectonics record of that portion of Central Australia. It is possible these conglomerate beds belong to the Ordovician formation, but lithologically they bear no resemblance to it; they do not antecede it in age. It bears closer resemblance to the Post-Ordovician formation, as seen in the South McDonnell Range, although in several respects the two are not analogous. The incipient metamorphism, and the semi-sphaerical exfoliation habit of weathering of Ayer's

(12) R. T. Maurice, Explorations. Parlty. Paper, Adelaide, 1904, pp. 30-31.

Rock, have little bearing on the point at issue. The writer thinks the South McDonnell and the Mount Olga lines of conglomerate may have been formed under somewhat similar conditions as regards situation, climatic conditions, and time, which may have been Devonian time.

But to return to the delineation of the Pre-Cambrian area: From Tanami the line runs south of east for many miles; and along this stretch recent sand-plains and sandhills completely hide from view the contacting rocks. Similar conditions prevail where the line turns and runs north again, to a point situated about twenty miles north of Tennant's Creek, where it again strikes the Winnecke Creek Tableland formation. This formation, which we last saw at Tanami, here forms the southern side of the low line of ranges, over which the telegraph line runs from the spot indicated to beyond Powell's Creek—120 miles. North of that the range is known as "the Ashburton." The point referred to is the low hill the telegraph line crosses two or three miles south of the Caraman waterhole, or swamp. In the Caraman, or Phillip's Creek valley an older series of rocks is seen.

TENNANT'S CREEK TO NEWCASTLE WATERS.

Going north from the Phillip's Creek, the Winnecke Creek formation is well developed, and is there, as elsewhere, composed of alternating beds of shale and sandstone, both being ferruginous, and of chocolate-brown colour. The sandstone strata are often flaggy. The beds undulate, with maximum dips of 10° or 15°. It should, perhaps, be stated here that the Winnecke Creek formation formerly formed a continuous sheet from near Tennant's Creek to Newcastle Waters, but that it now occurs only as large remnants—some of which stretch for several miles—but always is seen to occur as the uppermost rock formation of a partially-eroded tableland that extends west of the telegraph line.

Principally through fluvial erosion into its eastern escarpment, an older and more highly disturbed sedimentary formation than the above is exposed in many of the valleys and lowlands lying between Newcastle Waters and Tennant's Creek. These exposures are probably the southerly extension of the rocks of the Ashburton Range. On the watershed, a few miles south of Attack Creek, quartz veins traverse these older sendimentaries. At other exposures quartz rubble bestrews the surface. In places the rocks are upheaved to near the vertical. The strike is commonly north-north-west, but varies greatly in places from that direction. For the most part the strata of this formation, as seen along the telegraph line, are of quartzite and sandstone. As a suggestion only: the formation may be a continuation of the rocks underlying the Barkly Tablelands, in which, farther to the south-east, H. Y. L. Brown discovered Cambrian fossils, in limestone, from a well near the Alexandra Station, on the Barkly Tableland.

Typical examples of the Winnecke Creek Tableland formation occur in many places on the overland telegraph line. One is, the stretch over the tableland between Renner Springs and Banka Banka Station; and another, from 10 miles south of Attack Creek to Phillip's Creek. The "older series," before noted, may be seen at Banka Banka Station, Powell Creek, and at many other places. As a rule these latter are highly tilted, and show marked evidence of considerable disturbance. In places they enclose quartz veins. There is little lithological similarity between the two formations. There is, of course, a strong unconformity between them.

From the telegraph line, at the point before mentioned and situated twenty miles north of Tennant's Creek, the Pre-Cambrian line of contact apparently is with the Winnecke Creek Tableland formation as it runs east, but only for a few miles. It then turns south around a granite area for 20 miles, and then follows a south-easterly course along the north-eastern side of the granites, schists, and metamorphic slates that are exposed on the eastern side of the Murchison Ranges,

to 20° S.L. Along this stretch the Cambrian (?) rocks of the Barkly Tableland would appear to be the contacting series—as they are in the Murchison Ranges. There is uncertainty here, however, for over most of the distance the alluvial and sandy flats hide the actual contact. Still on south-easterly, the line passes near where Davidson discovered Cambrian fossils, in rocks that form the south-east extension of the Murchison and Davenport Ranges, at about 21°, 30′, S.L. How far south-east of that point one may assume the contact to be with the Cambrians is difficult to say. Very little is known of the south-eastern portion of the Pre-Cambrian area, and less is known about the age of the contacting rocks. When nearing Glen Annie the Cambrians take up the running, and continue the contact right to starting point. Away east of Glen Annie it is possible the Ordovicians are in contact, for that formation is reported to be well represented there.

NOTE.—Since this paper was written an interesting discovery of probably Ordovician fossils was made by Mr. N. B. Tindale, the Ethnologist of the Adelaide Museum. The fossils are in the forms of casts, in a quartzite matrix. One represents a species of *Orthoceras*, and another a species of *Raphistoma*. These closely resemble the Ordovician fossils of the Finke River region. The locality is a range of hills between the sources of the Plenty and the Sandover, that lies about 100 miles north-north-east of Arltunga. The range stands on the eastern slope of the Pre-Cambrian Plateau. Mr. Tindale's section indicates that the fossiliferous beds dip at a low angle to the north-east, and the formation, of which they form a part, reposes unconformably upon a still older and more highly disturbed sedimentary series which contacts with the Pre-Cambrian schists. The discovery is important, because it shows that the Ordovician formation originally had extensive development on the eastern slopes of the plateau. Our previous certain knowledge of it in Central Australia was largely confined to the southern slope. The order of succession of the three formations apparently correspond in both localities. North-east of Tindale's discovery, Davidson found Cambrian Trilobites in the lower sedimentary series.

THE WINNECKE CREEK TABLELAND FORMATION.

The writer's first acquaintance with this widespread formation was when opening up a line of waters between Barrow Creek and Victoria River, in 1909. When nearing 19° S.L. the sandhill country abruptly changed to a dark chocolate-brown colour, with firm ground bestrewn with ironstone pebbles. First a rise and then a descent into a "valley of erosion" were encountered. The descent was abrupt into this trough-shaped depression, which ran in a north-south direction. It proved to be an ancient watercourse, with a level, grass-covered bottom. Ferruginous sandstone, horizontally disposed, and occurring in layers, could, with some difficulty, be traced along the sides of the valley, and fragments of shale bestrewed the surface in places, indicating the presence of shale beds as well as sandstone. This formation was afterwards found to extend to Winnecke Creek, and from there on to Victoria River, in gentle undulations all the way. The wide depression in which Winnecke Creek runs is a similar "trough" to the one first mentioned, but much larger. Both are fluvially-eroded channels of considerable antiquity. The Camfield River is one of the large eastern tributaries of Victoria River. From Winnecke Creek to the Camfield this formation is one continuous sheet, with the exception of a small island-like exposure, of three or four square miles in extent, the rocks of which are slates and limestones, highly tilted in places and much disturbed. Quartz pebbles bestrew the surface of this small area, which lies fifty miles south-east of the Wave Hill Station.

Considerable areas of basalt are exposed in the Camfield River country. Some of the basalt hills there stand well above the level of the tableland formation, from which the latter has been eroded well back—erosion seeming to have taken hold of the ruptured state of the tableland formation around the volcanic necks.

The tableland formation extends from near the Mucka Outstation, on Victoria River, to south of Buchanan Hills without a break. The most easterly of any isolated hills of this formation, seen by the writer in the Winnecke Creek

district, is the solitary pinnacle—Lothario Hill—situated some 25 miles east of Buchanan Hills. The hills owe their preservation to an indurated capping, and represent the more easily erodable upper beds, of sandstone, of this formation. The lower beds of shale and conglomeratic sandstone being more resistant, extend over vast areas. Its occurrence on the overland telegraph line has already been noted. Notwithstanding that the writer has not travelled over all the country lying between Winnecke Creek and the overland telegraph line upon the formation, he is quite satisfied, from its mode of occurrence in both localities, and the lithological similarity everywhere seen, that formerly (if not at present) the Winnecke Creek Tableland formation covered the area between those districts.

Good sections of this formation may be seen at Ross Gap, and on the steeper sides of the Winnecke Creek valley, a few miles below that spot. At the Gap there is much ironstone. On either side of the creek, at the Gap, are small, low hills of ironstone, that run back from the creek a mile or two. Buchanan Hills are the most easterly of a number of flat-topped hills that occur in the Tanami region, at the head of Winnecke Creek, and around the Gardiner's Range, and, as set out earlier in this thesis, Talbot carries these hills and the formation well on towards Wiluna, in Western Australia. He regards its age as Carboniferous, *i.e.*, Permo-Carboniferous, and maps it as such. The writer now extends its area from Tanami to the overland telegraph line, over the country lying between 17°, 30′, S.L, and 19°, 30′, S.L., or, in other words, between Tennant's Creek and Newcastle Waters.

In places in the valley of the Victoria River and its tributaries a still older, and considerably disturbed, sedimentary rock formation occurs. It is composed of limestones, shales, sandstones, quartzite, etc., that may, judging from Talbot's descriptions of rocks of that age that occur over the Western Australian border, be of Devonian age. The most southerly exposures of the basalt in the Victoria River area, seen by the writer, extended from Mucka Outstation east to a few miles beyond the big south-east bend of Victoria River. In no case, notwithstanding that the tableland formation covers such extensive areas of country, did it appear to have had any very great vertical dimensions. The soil derived therefrom is very poor in comparison with that from the basalt in the Victoria River district.

A NORTH-SOUTH CORRELATION.

Judging from Talbot's map and descriptions as set out in the bulletin mentioned above, and also from what may be gathered from the explorer's journals —which, unfortunately, is very meagre—it may reasonably be inferred that the Devonian formation, as typified in the Gardiner's Range at Tanami, has its counterparts in at least some of the remnants extant on the slopes leading off the plateau. A few of these remnants, as would appear to answer to the requirements, have already been mentioned. Should those selected, or any of them, meet the case, the important fact would be established that the Devonian formation was well represented on both the lower and higher slopes of the plateau. Such a discovery would elucidate many points now inexplicable, or, at any rate, litigious. On the northern slopes of the plateau such remnants are perhaps more likely to be found in the broad, ancient valleys of the Hanson and Lander Creeks under the lee of former high ranges. Mounts Barkly, Denison, and Leichardt appear to be located in favourable situations. The writer has experienced doubts as to which formation Central Mount Stuart and other hills in that neighbourhood belong, but, unfortunately, has never had the opportunity of verification, notwithstanding that he has passed through that part many times. On the southern slopes of the plateau lies the Post-Ordovician sandstone-conglomerate formation, before referred to, which is situated in a "protected area," and might very well be of Devonian age.

On the southern slopes erosion had already removed a large, if not the greater, portion of the massive Post-Ordovician formation prior to the deposition of the next succeeding sedimentation of which we are cognisant. Over large areas, and in different localities, these "Post-Post-Ordovician" beds, or Finke River Series, repose on Ordovician, or rocks of still greater age. The writer has satisfied himself that the conglomerate beds in the Finke River Series, near Crown Point, and which for the most part are composed of quartzite pebbles and boulders, were largely "derived" from the Post-Ordovician conglomerate beds that are so well developed in the South McDonnell Ranges. David and Howchin regard the Finke River Series as of Permo-Carboniferous age. It is certainly younger than the Post-Ordovician, for it is known to repose, unconformably, upon it. Lithologically the two are most unlike. The Post-Ordovician beds undulate, while the Finke River Series lie very near the horizontal. The former, in the Finke River region, attain a greater elevation than the latter. Originally a thousand feet or more.

As regards disposition *(viz.,* lying near the horizontal) and lithological similarity *(viz.,* sandstone overlying shale beds), the formation is similar over very wide areas. We have the Finke River Series on the southern slopes, and the Tanami to overland telegraph line Permo-Carboniferous beds on the northern slopes, with a great extension of the same formation towards Wiluna, and to Derby on the west coast.[13] H. Y. L. Brown also noted the same formation in different places on the north coast, all of which go to show how widespread the formation is in Australia.

There appears to be no reason to doubt that the whole belongs to, or originated in, one contemporaneous sedimentation, and from the evidence we have the following epitome may be deduced:—

(a) The plateau, as an elevated tract of land, was in existence, and its present form and features, in a general way, had been determined before Permo-Carboniferous sedimentation.

(b) Only remnants of the Post-Ordovician series remained on the plateau slopes during the Permo-Carboniferous sedimentation, but they show that the latter never reached the vertical elevation of the former by at least a thousand feet.

(c) The plateau has been a "fairly stable region" from early Permo-Carboniferous times to the present, and similar stable conditions appear to have obtained over much of the western two-thirds of the continent during the same time.

(d) The Permo-Carboniferous strata that covered the higher southern slopes of the plateau, together with practically the whole of the area covered by that formation lying to the north and west of the plateau area as well, show no indications of ever having been covered by any later marine sedimentation. Sub-aerial conditions appear to have persisted over the area through all subsequent time. The lower beds indicate sub-aqueous still-water conditions during their formation, but the frequent occurrence of long, thin lenses of pebbles and small boulders in the middle and upper beds that occur on both the north and south sides of the plateau indicate shallow water conditions, while sub-aerial and even Arctic glacial conditions obtained during the formation of the upper beds on the Finke. The interleaved long lenses of haematite and limonite point to lacustrine conditions. Heavy ironstone bands are a conspicuous feature in the Winnecke Creek area.

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(13) Natural Regions in W.A., by E. de C. Clarke. Jour. Roy. Soc. of W.A., vol. xii., pp. 117-132.

(e) The upper Permo-Carboniferous beds are extremely pourous, and it is they that form the intake, and the water channel, beds of the Lake Eyre artesian basin around its north-western rim. These porous beds are very favourably situated, as regards elevation, to catch the rainwaters that drain off the eastern and southern slopes of the plateau. The rain that falls on sandy areas that cover the intake beds probably augments the supply also. Sinking immediately into the sand it doubtless percolates to the intake beds. The bore at the Finke railway crossing probably indicates the horizon at which the sub-artesian supplies are standing in the intake beds on the Finke. In north and north-west Australia, over very large areas, this formation, as just stated, appears not to have been covered by any younger sedimentation, but off the east and south-east sides of the plateau the beds plunge into the Lake Eyre basin, and are there known to be covered in places by over 5,000 feet thick of superincumbent Mesozoic and Tertiary strata.

In ascending order, the sedimentary formations known to the writer to have either partially or wholly covered the plateau are as follows:—

(1) *The Pre-Cambrian Complex*—the foundation rocks of Central and North Australia—are of, apparently, both igneous and sedimentary origin. Proterozoic.

(2) *Cambrian*—Certain localities yield *Cryptozoön,* and others *Agnostus, Microdiscus* and *Olenellus,* trilobite fossils.

(3) *Ordovician.*—Various spp. of trilobites and other characteristic fossils of that age occur in many places, and over wide areas.

(4) *Post-Ordovician—Devonian (?)*—A massive formation, reduced greatly by denudation, that is characterised by quite phenomenal accumulations of conglomerate. Only "derived" Ordovician fossils discovered to date.

(5) *Permo-Carboniferous.*—The age of this formation has been arrived at by tracing the extension of beds of determined age, on the north, and by analogy of those occurring on the south side of the plateau.

NOTE.—*The Jurassic, Cretaceous, and Tertiary* formations of the Lake Eyre region appear not to have ascended the slopes sufficiently far to leave remnants on, or impinging on the plateau.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY, CENTRAL AUSTRALIA
NO. 8 – A TABLE SHOWING THE CLASS RELATION OF THE ARANDA

BY H. K. FRY, B. SC., M.B.B.S (ADEL.), ETC

Summary

One of the most interesting features of the Australian Aboriginal is the social organisation of the tribes into classes which regulate marriages. These arrangements are clear cut and precise to the natives, even the small children can state at once the class to which all their acquaintances belong, and what relation tribally they bear one to another. But when an enquiring mind is brought to bear on the matter, the problem soon develops into such a complicated maze that interest is apt to cool off in this direction and become diverted into less bewildering fields of study.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY, CENTRAL AUSTRALIA.

No. 8.—A TABLE SHOWING THE CLASS RELATIONS OF THE ARANDA.

By H. K. Fry, B.Sc., M.B.B.S. (Adel.), B.Sc., D.P.H., Dipl. Anth. (Oxon.).

[Read May 14, 1931.]

One of the most interesting features of the Australian Aboriginal is the social organisation of the tribes into classes which regulate marriages. These arrangements are clear cut and precise to the natives, even the small children can state at once the class to which all their acquaintances belong, and what relation tribally they bear one to another. But when an enquiring mind is brought to bear on the matter, the problem soon develops into such a complicated maze that interest is apt to cool off in this direction and become diverted into less bewildering fields of study.

The Aranda are the type example of an eight-class nation. The Table I. presented here gives a compact picture of the mutual relations of these eight classes. It undoubtedly appears complicated at first glance, but it so happens that it works out on such unexpectedly simple geometrical lines, that I venture to think that, in helping to visualise the intricacies of the complex problem, it elucidates a difficult subject.

The scheme of the table was worked out during the visit of the Adelaide University Anthropological Expedition to Hermansberg in August, 1929, carried out with the aid of a grant from the Australian National Research Council.

The spelling of the class names is that of Strehlow. Males of the various classes are indicated by the class names printed in small type, females are shown by the names printed in large type, *e.g.*, Pananka for the male, PANANKA for the female. The names fall into alternate horizontal rows of four males and four females. Lines of four varieties are used, each showing a constant relation to a pair of male names. The thick and thin continuous lines are in relation to males of "A" moiety, thick and thin dotted lines to males of "B" moiety. The vertical portions of the lines represent direct male and direct female descent. The horizontal portions of the lines linking the vertical portions of corresponding character, indicate a marriage union, thereby linking husband and wife above as parents, and brother and sister below as children. For example, Panaka marries PURULA, and their children are Bangata and BANGATA; BANGATA is married to Mbitjana, and their children are NGALA and Ngala.

The right and left margins of the table are to be considered as contiguous, as would be the case actually if the diagram were mounted on a vertical cylinder. Consequently, a line ending free on one margin is to be read as continuous with the free end of the corresponding line at the opposing margin.

The bottom line is a replica of the top line. The names, of course, represent different individuals in a genealogical table, but are identical from a class relation point of view. Therefore, the table could also be mounted on a horizontal cylinder, and its general form is that of the surface of a solid ring.

For working purposes the plane presentation is more simple and the diagram can be extended, if necessary, by repetition in all directions.

An inspection of the table shows the males in four vertical lines, each with two alternating names of the same moiety. The females fall into four vertical lines of alternating moiety, the first and third lines containing the same four names, and the second and fourth the other four. In these paired lines, female names alternate in pairs.

The third row shows the same actual marriage linkages as the top row; the fourth the same as the second.

The lightly drawn linear system, as a whole, is a replica of the linear system in heavy lines. The dotted line system is a mirror image of the continuous line system displaced one generation.

The "A" and "B" moiety names can be transposed without altering the form of the diagram.

The table, therefore, shows the inherent regularity of form which is demanded of it by the nature of the problem which it is intended to illustrate.

The table can also be drawn up in a generalised form, so that the appropriate class names of any eight-class tribe can be applied to it. This is indicated by the lettering above the class names, where a1′, a1″, a2′, a2″ represent males of the four subclasses of "A" moiety, b1′ b1″, b2′, b2″ males of "B" moiety, arranged as in the diagram according to their marriage relationships. A1′, A2″, A2′, A2″, B1′, B1″, B2′ B2″ similarly represent females of their respective moieties.

It will now be seen that the group (a1′, A1′, b1′, B1′, a2′, A2′, b2′, B2′) is correlated with the thick line system, and the group (a1″, A1″, b1″, B1″, a2″, A2″, b2″, B2″) with the thin line system. There are many tribes such as the Southern Aranda and the Warrai which have a four-class nomenclature with an eight-class organisation. Each class name, therefore, covers two subdivisions which are stated to bear the mutual relation of "ipmunna"(1) to one another. These are represented by the a1′ and a1″ groups (thick and thin line, respectively) mentioned above.

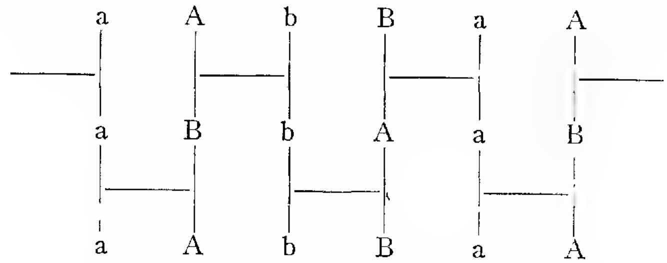
If the Aranda table be compared with Table II., in which the class names of a typical four-class tribe, the Kariera, are tabulated by a similar representation of marriage and descent, it will be seen that the eight-class table represents a quadruplication of a four-class diagram, by a duplication of class names (ipmunnas) and a change from a two-generation to a four-generation cycle. The complexity of the linkage lines of the eight-class table is due to the interchange of the female ipmunnas A1′ and A1″, B1′ and B1″, A2′ and A2″, and B2′ and B2″, in the third and fourth generations as compared with the first and second generations.

If the class names of a two-division tribe such as the Warrunjerri be charted on the same plan as above, it will be found that the pattern of the four-class diagram is reproduced.

So far tribes of paternal descent only have been considered. In the case of tribes of two moieties or four classes, such as the Urabunna and Kamilaroi, respectively, in which maternal descent is the custom, the four-class diagram will be found to hold good if the a1, A1, etc., terms be transposed so that the male vertical lines then show the alternation of moiety in succeeding generations.

No instance is known of a fully-fledged eight-class system with maternal descent, but the table would work out equally well for maternal descent. There is the interesting example of the Dieri, with two moieties only but with an eight-class organisation. Howitt's genealogical table of the Dieri(2) will be found to follow the pattern of the Aranda table if the a1, A1 terms be transposed.

With regard to the form of the four-class table, the following more simple linkage would appear to give a satisfactory picture of the marriage and descent relationships :—



But it will be noticed that the only marriages provided for in this arrangement are those of a man's marriage with his father's sister's daughter, and a woman's marriage with her mother's brother's son. The converse marriages with mother's brother's daughter and father's sister's son are not represented. To provide for these the long links of the four-class diagram are necessary, and it will be found that this diagram in a new way represents a three dimensional form. Imagine a square vertical column seen from the front of one face, and let each vertical edge represent one of the vertical lines of the diagram. The Banaka BURUNG marriage links will run across the front face, the BANAKA Burung across the back face. The marriage links Palyeri KARIMERA, and PALYERI Karimera, will run from before backwards on the lateral faces of the column. Marriage links of alternate generations are, therefore, diagrammatically on planes at right angles to one another. This can be shown in another way. If each line of the diagram be written as if seen from above, the form of the three rows will be as follows :—

A1	b1		B2	b2		A1	b1
a1	B1		a2	A2		a1	B1
First Row			Second Row			Third Row	

where sides aA, bB represent brother and sister relationship, and sides aB, bA that of husband and wife.

The geometrical form of the eight-class table can now be reviewed and interpreted in the light of the information provided by this simpler table.

The point of view is from above in the following representation of the successive rows (generations) of the more complex table.

A1′	b1′	A1″	b1″		B2′	b2′	B2″	b2″
a1′	B1′	a1″	B1″		a2′	A2′	a2″	A2″
First Row					Second Row			
A1″	b1′	A1′	b1″		B2″	b2′	B2′	b2″
a1′	B1″	a1″	B1′		a2′	A2″	a2″	A2′
Third Row					Fourth Row			

If these diagrams are compared with the four class, it will be found that exactly the same process is taking place, only the marriage links of the second and third rows join corresponding units of two squares. In the first row marriage lines connect units of front and back rows of individual squares. In the second row the lines, instead of running back along the sides of individual squares, join the "opposite number" of the other square, a2′ links with B2″ instead of B2′, b2′ with A2″ instead of A2′, and so on. In the third row the transverse connections run between squares round the ring of the diagram, and in the fourth row the linkage is front to back in individual squares, as in the second figure of the four-class diagram.

The ring structure of the diagram is readily reconstructed for the four-class table; for the Aranda table a form comprising the outer and inner surfaces of a hollow ring would appear to be necessary.

Turning now to the practical value of the table. Firstly, there are two interesting features in regard to nomenclature. In tribes with an eight-class organisation and a four-class nomenclature, the named classes are almost invariably those represented by the a1′, b1′, a2′, b2′ positions in the table. The Mara[(3)] and Anula tribes are exceptions. Here the four named classes, when charted, occupy the top line of the diagram in the positions a1′, b1′, a1″, b1″. Otherwise the tabulation works out quite normally. Spencer states that the Mara represent an instance of direct as opposed to an ordinary indirect paternal form of descent. If I read the table rightly, the Mara represent an unusual form of nomenclature not of descent.†

Some eight-class tribes, such as the Warramunga[(4)] (male descent) state that their classes are grouped in pairs, and the paired classes bear a mutual relation of mother's mother to one another. If the class names are tabulated according to the Aranda diagram, it will be found that these paired names fall into relative positions, such as that of PURULA and NGALA.

A most important service is rendered by the table in the study of relationships.

The vertical lines of direct male and female ascent have been mentioned before, the male showing four groups of subclasses of constant moiety and two-generation cycle, the female two groups of alternating moiety in a four-generation cycle.

For diagonal lines of symmetry the ring nature of the diagram demands a repetition of the plane table in all directions.

Firstly, take any female name of "A" moiety. One generation below and one female place to the right will be found brother's daughter. Lay a ruler on the diagonal line set by these two names, and the diagonal will be found to traverse a series of female names representing the relationships: father's father's sister, father's sister, self, brother's daughter, brother's son's daughter. This series represents a complete circuit of the ring, and therefore is capable of extension *ad infinitum*.

From the woman's brother's point of view the same series of relations is expressed by the same line, except that the names are altered to father's father's sister, father's sister, sister, daughter, and son's daughter. The relationship of wife is one generation directly above that of daughter, and one female place right of sister in the same generation.

An exactly similar series will be found for "B" moiety males and females, only in this case the diagonal extends from above downwards to the left.

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†Since this paper was written, I find that Brown has made this same deduction, "Oceania," vol. i., 1930, p. 40.

Table I.—Showing the Class Relations of the Aranda.

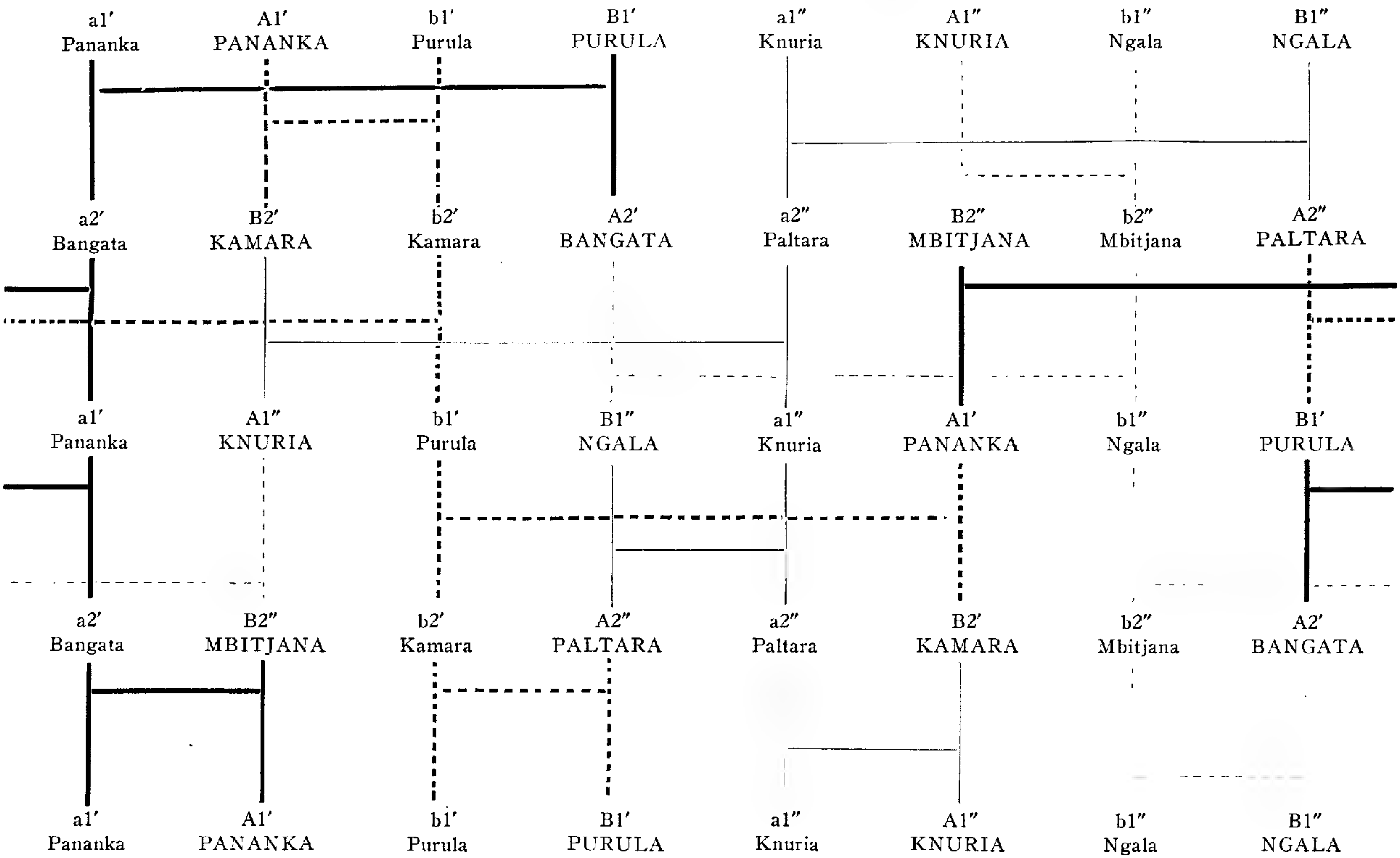


Table II.—Showing Four Class Relationships.

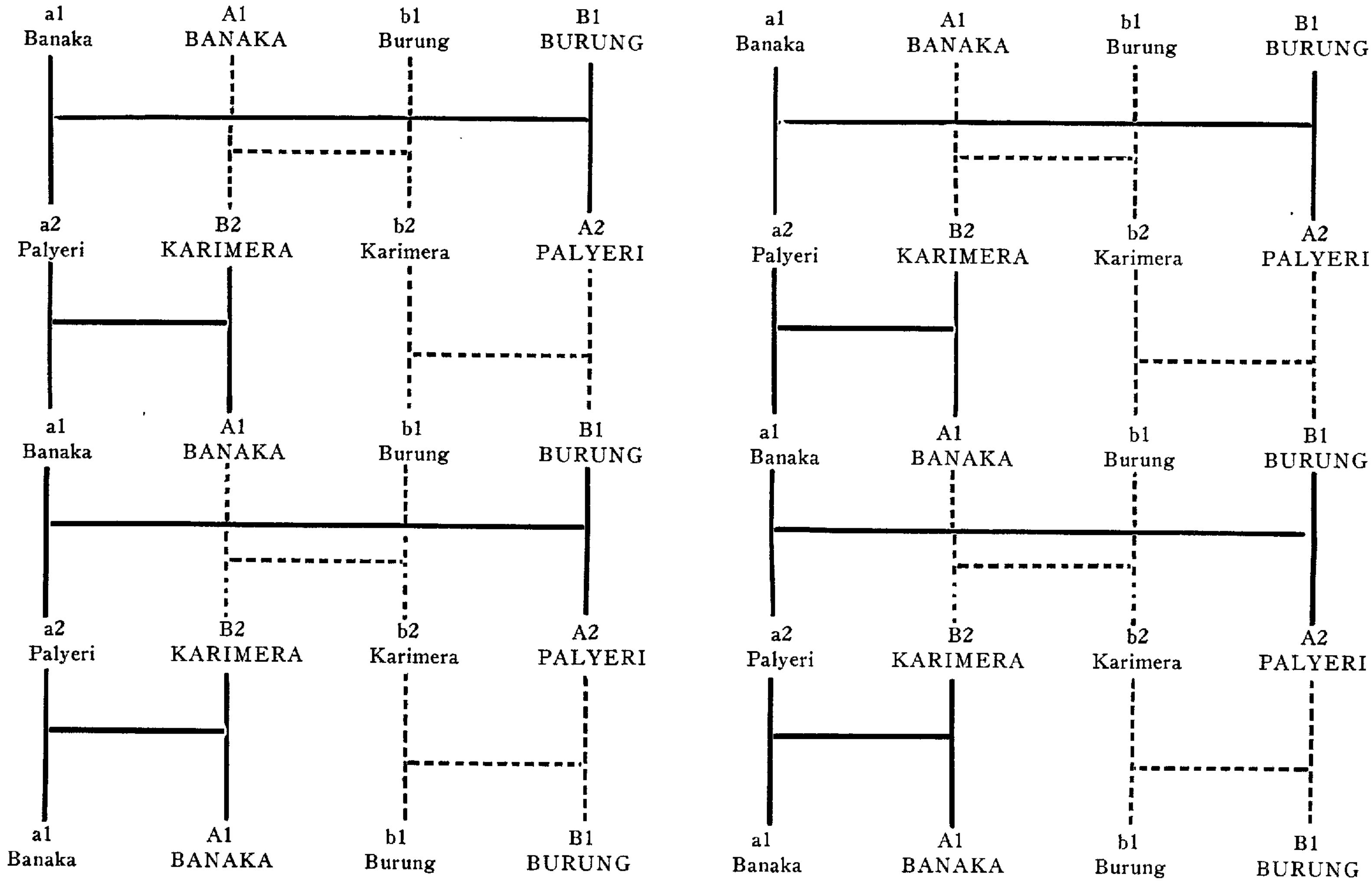
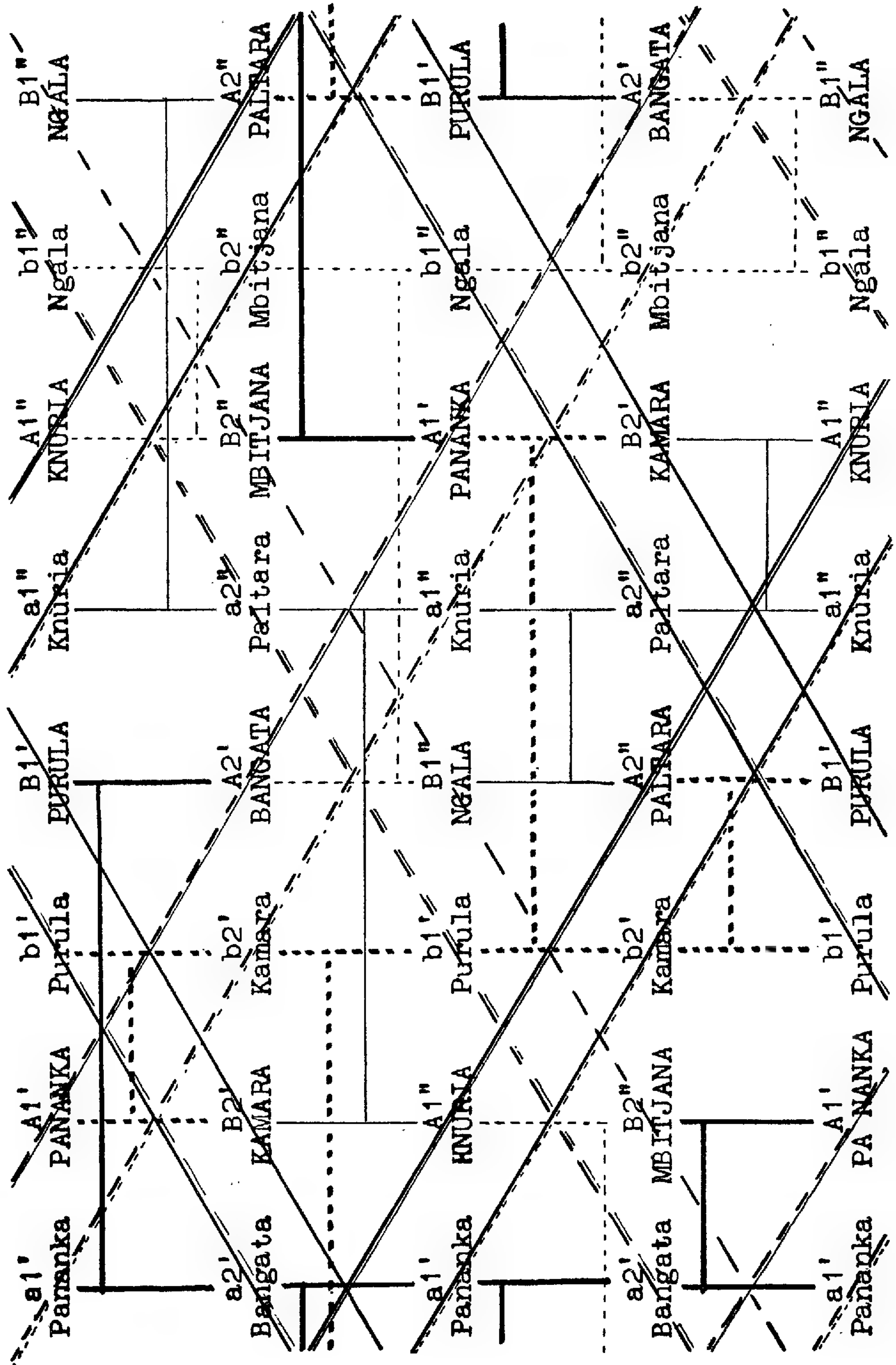


TABLE III.



a1' Pananka
A1' PANANKA
b1' Purula
B1' PURULA
a1" Knuria
A1" KNURIA
b1" Ngala
B1" NGALA
a2' Bangata
B2' KAMARA
b2' Kamara
A2' BANGATA
a2" Paltara
B2" MBITJANA
b2" Mbitjana
A2" PALTARA
a1' Pananka
A1" KNURIA
b1' Purula
B1" NGALA
a1" Knuria
A1' PANANKA
b1" Ngala
B1' PURULA
a2' Bangata
B2" MBITJANA
b2' Kamara
A2" PALTARA
a2" Paltara
B2' KAMARA
b2" Mbitjana
A2' BANGATA
a1' Pananka
A1' PANANKA
b1' Purula
B1' PURULA
a1" Knuria
A1" KNURIA
b1" Ngala
B1" NGALA

The relationship series mother's mother's brother, mother's brother, brother, son, and daughter's son, from a female standpoint, will be found to lie on a diagonal swinging down and right for subclasses A1′, A1″, B2′ B2″, down and left for subclasses A2′, A2″, B1′, B1″. Husband relationship keeps step one generation above that of son, and one male place right or left of brother. This line indicates the series mother's mother's brother, mother's brother, self, sister's son, sister's daughter's son, from the male point of view.

On these diagonal lines of relationship, it will be found that the female names recur in pairs of constant moiety, the males in two groups of alternating moiety. This is the converse of the vertical lines of relationship.

In Table III., where these lines are indicated, it will be seen that there are four lines of male and four of female connections, the same number as are represented as vertical lines in Table I. If any female oblique line series is compared with any male oblique line series, it will be found that the class names of the respective male and female of the same generation bear to one another a relationship of husband and wife, brother and sister, "ipmunna" to husband or wife, "ipmunna" to brother or sister, in a cycle of successive generations. This again is the exact counterpart of the relation of male and female expressed by the vertical lines. In other words, the pattern of the oblique system of lines is that of Table I., charted for maternal instead of paternal descent, which, as we have stated before, involves no change of pattern of the linkage system. Consequently, the table can be looked upon as a lattice system, hinged on class names of one horizontal row. If the lattice is built with the paternal descent pattern in rectangular form, swinging the vertical lines to a diamond pattern will give the maternal descent form in vertical series; conversely, if built for a maternal descent pattern in the rectangular form, swinging it to a diamond lattice will give the paternal descent arrangement in vertical series. The reciprocating nature of the oblique and vertical relationship series of Table I. with the alternation of paternal and maternal descent is clear.

An expert practical craftsman devoid of theoretical knowledge, can adapt his materials to a new use with the correct technique. In the same way the Urabunna, a two-moiety tribe with maternal descent, and the Aranda, a tribe with an eight-class organisation and paternal descent, are able to make satisfactory arrangements for inter-marriages[5]. This is an interesting example of successful practical application without, necessarily, any appreciation of the theoretical principles involved.

The lattice for the four-class system is similar to the eight-class table, except that in the four-class type there are no "ipmunnas," so the relationships of the class names in the same row in both vertical and oblique systems are those of sister and wife alternately, and four vertical and four oblique lines with a two-generation cycle comprise the relationship series.

References.

(1) Spencer and Gillen, "Native Tribes of Central Australia," p. 71.
(2) Spencer and Gillen, "Northern Tribes of Central Australia," p. 118.
Spencer, "Native Tribes of the Northern Territory," p. 60.
(3) Howitt, "Native Tribes of South-East Australia," p. 159.
(4) Spencer and Gillen, "Northern Tribes," p. 104.
(5) Spencer and Gillen, "Native Tribes of Central Australia," p. 69.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY, CENTRAL AUSTRALIA
NO. 8 – ON THE CLASS SYSTEM, KINSHIP TERMINOLOGY, AND MARRIAGE REGULATION OF THE AUSTRALIAN NATIVE TRIBES

BY H. K. FRY, B. SC., M.B.B.S (ADEL.), ETC

Summary

In a recent paper I have described tables of Australian class systems.[1] These were a development from one of several attempts to represent compactly the class organisation of the Aranda. Class names were charted in vertical lines of male and female descent, and horizontal lines were drawn to indicate marriage unions. The class names of a four-class system were arranged, then, on a similar plan, and the implications of the eight-class table began to appear. The class names of a two-division tribe were found next to fall in the same pattern as the four-class table. An attempt to find a more simple pattern for the two-class tribal system gave the clue to the "double cross-cousin marriage" nature of the form of the table which had been found previously. This led to the full interpretation of the form of the eight-class table. Diagonal lines of "wife" relationships were apparent in the Aranda table as soon as it was drawn up. Other lines of relationship series were found by charting simple relationships on the table in the manner of plotting graphs on squared paper. The tables were drawn up, therefore, without any reference whatever to native relationship terminology, but show patterns of relationships.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY, CENTRAL AUSTRALIA.

No. 9.—ON THE CLASS SYSTEM, KINSHIP TERMINOLOGY, AND MARRIAGE REGULATION OF THE AUSTRALIAN NATIVE TRIBES.

By H. K. Fry, B.Sc., M.B.B.S., D.P.H., Dipl.Anth.

[Read July 9, 1931.]

In a recent paper I have described tables of Australian class systems.(1) These were a development from one of several attempts to represent compactly the class organisation of the Aranda. Class names were charted in vertical lines of male and female descent, and horizontal lines were drawn to indicate marriage unions. The class names of a four-class system were arranged, then, on a similar plan, and the implications of the eight-class table began to appear. The class names of a two-division tribe were found next to fall in the same pattern as the four-class table. An attempt to find a more simple pattern for the two-class tribal system gave the clue to the "double cross-cousin marriage" nature of the form of the table which had been found previously. This led to the full interpretation of the form of the eight-class table. Diagonal lines of "wife" relationships were apparent in the Aranda table as soon as it was drawn up. Other lines of relationship series were found by charting simple relationships on the table in the manner of plotting graphs on squared paper. The tables were drawn up, therefore, without any reference whatever to native relationship terminology, but show patterns of relationships.

Radcliffe Brown has made an intensive study of Australian social organisation, especially from the point of view of native kinship terminology. He has drawn up tables of Kariera type and Aranda type kinship terminology.(2) In these, kinship terms are correlated with an arrangement of classes which are represented by a notation which is different to the general notation used in my tables. Brown adopts capital letters for males, small type for females. I happened on the opposite convention. Brown's notation corresponds with mine as follows:— In the Kariera tables, A = a1, B = b1, D = a2, C = b2; in the Aranda tables, A1 = a1′, A2 = a1″, B1 = b1′, B2 = b1″, D2 = a2′, D1 = a2″, C1 = b2′, C2 = b2″.

The similarities between the two sets of tables are interesting. The Kariera tables are very much alike. In the Aranda tables the same males appear in the vertical lines, which are in different order. If the order of the lines in the kinship table is altered from P R S Q to P R Q S, so making the left half of the table symmetrical with the right half, it will be found that the correspondence of the males in the two Aranda tables is as close as that shown in the two Kariera tables. The four vertical series of "wives" in the kinship table are represented in four diagonal lines in the class table, and conversely the four vertical lines of direct female descent in the class table appear in four diagonal lines in the kinship table, in the P R Q S rearrangement.

The relationships are expressed in the kinship table as translations of the actual native terms, which Brown supplies elsewhere.(3) (4) Several alternative translations are possible for many of the native terms, as will be seen by tracing

out the linkages of either the kinship or the class table. Either table is equally effective.

This demonstration is of importance because it shows that virtually identical results can be obtained by working out the implications of either native kinship terminology or class division.

Brown has taught [5] that the regulation of native social life in general, and of marriage in particular, is the result of native kinship terminology alone. These views have been widely accepted. But this acceptance has been more passive than active, owing to the extreme difficulty of comprehending the complexity of the terms, involving multiple variants, with which the theory in question has been supported. With the aid of the class tables it is possible to visualise the significance of involved relationship terms.

A close study of the data, which have been used to support the theory that social organisation and marriage are dependent only upon the laws of relationship terminology, will show that an explanation is provided equally well by the use of class considerations alone.

The same will be found to be true in regard to the "characteristic features" of Type I. and Type II. marriage law. Further, the marriage permitted by the Variety (a) of Type II. marriage law will be found to be, not a variety of, but a direct contradiction of, the marriage law Type II.

In typical Australian tribes, all the tribal members are representatives of some one class, and are all relatives.

Class tables are genealogical tables of male and female representatives of all the tribal classes, and show relationships genealogically.

The virtual identity, with these, of the tables of kinship terminology is due simply to the fact that the tribal representatives in the latter are arranged in accordance with the *genealogical interpretation* of their respective relationship terms, and are built up in this way into a genealogical table.

It will be seen, therefore, that Radcliffe Brown in his tables, and in his writings generally on Australian social organisation, is dealing, not with mere native kinship terminology, but with the genealogical significance of native kinship terminology, which is identical with the genealogical significance of the native class system.

The theory that Australian native social organisation and marriage are determined by kinship terminology, and not by class system, therefore depends upon a subtle distinction which is actually non-existent.

The question as to what has been the determining factor underlying the development of the more complex class systems is a matter for speculation. There is the explanation from the premises of kinship terminology that an antipathy to marriages of near consanguinity has demanded marriages between individuals of local groups representing comparatively distant degrees of consanguinity, and that a systematisation of such arrangements has resulted in a dichotomy of class nomenclature This can not be disproved in the absence of historical evidence. On the other hand, with the key of the existing class systems, it is a simple matter to draw up organisations for sixteen and thirty two-class systems, the latter with two main alternatives and several minor alternatives. It would be a very difficult matter to work out such arrangements from the basis of relationship terminology. An argument based on class arrangements could explain the more complex organisations by dichotomy or agglutination of pre-existing units. Whether class considerations of themselves have been a primary factor in such development or not is again only speculation, but they have the virtue of enabling things as they are to be expressed graphically and simply.

Similarly the conditions of native marriage may be summarised simply as follows:—

1. The tribal class system determines that a man may marry any woman of his own generation and of a certain class or subclass, named or unnamed, and each such woman is called "wife."
2. "Local rules" in different tribes may:
   (i.) Prohibit marriage with certain "wives."
   (ii.) Permit marriage with women of the same class as "wives" but belonging to a second ascending or descending generation.
   (iii.) Permit "prohibited" marriages with women of a different class to that of "wives" under exceptional circumstances.

The attempt to formulate these conditions into "fundamental laws of relationship terminology" has resulted in an increased complexity of reasoning, and fallacy in deduction. There is also a constant tendency for arguments based on native kinship terminology to drift into arguments involving relationships of consanguinity only.

The class nomenclature system provides relatively simple and safe lines of argument in the investigation of the Australian social organisation, and a useful check on deductions drawn from the more complex terms of kinship.

Addendum.

An illustration of the above is provided by Brown's description of the Yaralde kinship and marriage system, in "Oceania," vol. i. part iv., 1931, p. 452, in terms which imply a latent organisation into at least thirty-two subclasses in a tribe without any class nomenclature. This, of course, is not impossible, but certainly raises the question whether an error has not crept in somewhere.

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(1) H. K. Fry, Trans. Roy. Soc. S. Austr., vol. lv., 1931, p. 12.
(2) A. R. Brown, *Oceania,* vol. i., 1930, pp. 49 and 50.
(3) *Ibid,* p. 323.
(4) A. R. Brown, Journ. of the Royal Anth. Inst. of G. B. and I., vol. xliii., 1913, pp. 153 and 154.
(5) *Ibid,* p. 190, *et seq.*

THE ANATOMY OF AN AUSTRALIAN LEECH, HELOBDELLA BANCROFTI

BY EFFIE W. BEST (NEE DELAND), M.SC

Summary

The material studied consisted of three specimens collected by Dr. T. L. Bancroft, and presented to Professor T. Harvey Johnston, by whose kindness I was enabled to examine it. Two individuals were in the form of whole mounts, and the third has been prepared as a series of transverse sections. The leeches were obtained from a turtle, *Emydura krefftii,* in the Burnett River, Queensland, but no information is available as to their colour and markings in life. The crops of all three specimens were distended with blood.

THE ANATOMY OF AN AUSTRALIAN LEECH, HELOBDELLA BANCROFTI.

By Effie W. Best (née Deland), M.Sc.

[Read May 14, 1931.]

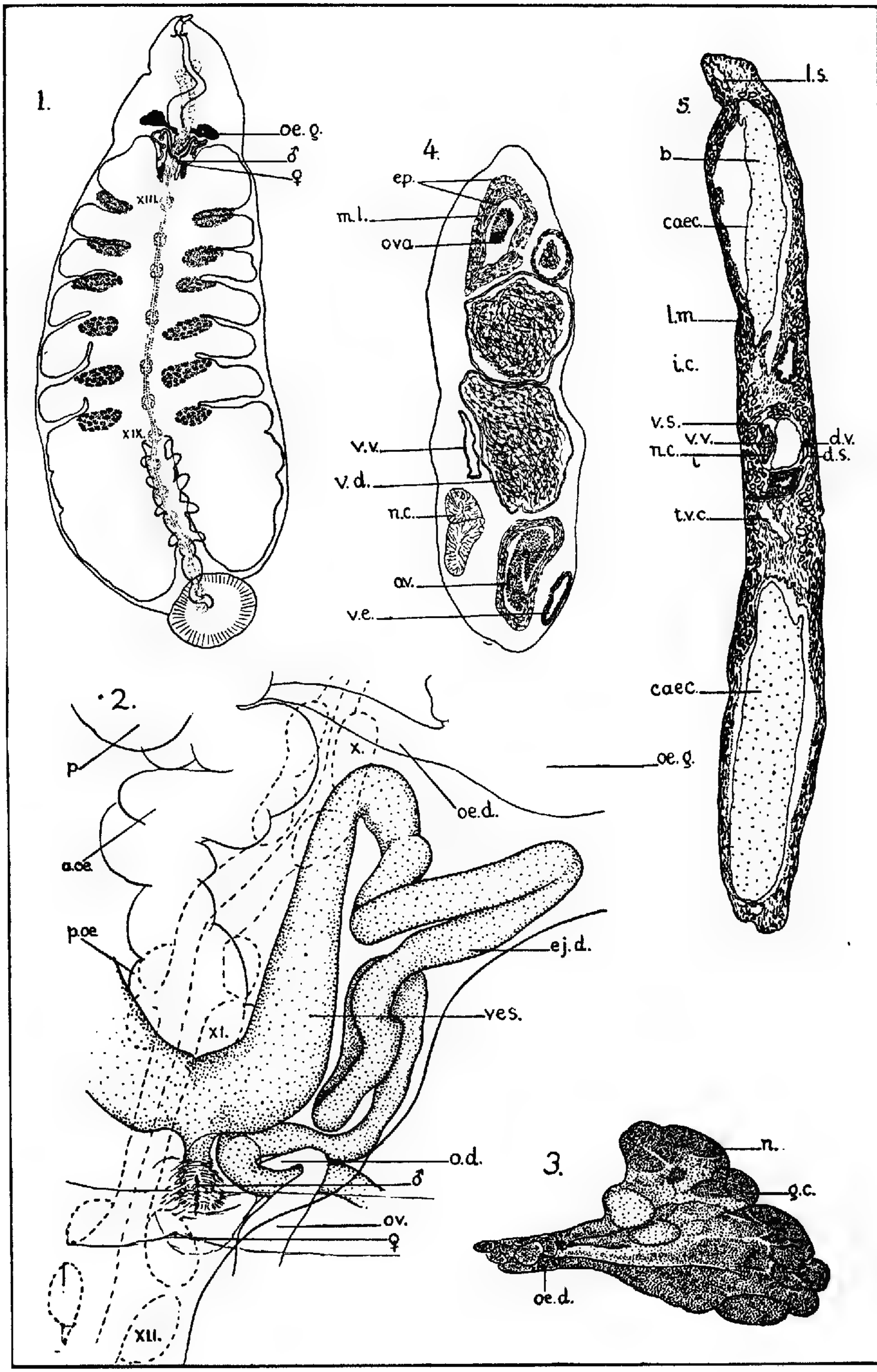
The material studied consisted of three specimens collected by Dr. T. L. Bancroft, and presented to Professor T. Harvey Johnston, by whose kindness I was enabled to examine it. Two individuals were in the form of whole mounts, and the third has been prepared as a series of transverse sections. The leeches were obtained from a turtle, *Emydura krefftii*, in the Burnett River, Queensland, but no information is available as to their colour and markings in life. The crops of all three specimens were distended with blood.

This species of *Helobdella* is small, measuring only 6·8 mm. in length and 2·6 mm. in greatest width, and is greatly flattened dorso-ventrally. The leaf-like general form is shown in fig. 1. The mouth is sub-terminal, lying on the second annulus, and the anterior sucker is inconspicuous. The posterior sucker is circular, with a diameter of 1 mm. and is distinctly marked off from the body. The anus opens in the centre of its disc. A pair of eyes is conspicuous at the anterior end of the body, but no segmental sense organs could be recognised. The genital apertures are situated immediately in advance of ganglion 12, and are separated by a single annulus.

Annulation was not obvious in the preparations as mounted, so that internal structures are referred for their position to the nerve ganglion rather than to the superficial marks of segmentation unless the contrary is definitely stated.

The general form of the body wall shows a certain amount of variation in different regions. This is due to the variable proportions of muscular, glandular, and other elements present, rather than to any alteration in the structures composing it. A typical section is shown in fig. 7. The cells of the epidermis are very irregular in shape, approaching a columnar form only at the extremities of the body and in the neighbourhood of the genital apertures. A very large number of epidermal cells are highly granular and modified as unicellular glands. Some of these may be sunk two or three times the depth of the epidermis below the surface, in which case their secretion is poured out through a narrow duct-like prolongation. The epidermis rests on a layer of fibrous connective tissue, the cells of which have particularly deeply-staining, compact, spindle-shaped nuclei. There is no sign of the definite arrangement of longitudinal, circular, and dorso-ventral muscle layers which characterises the more highly organised leeches. Most of the muscle fibres, except those which run in the incomplete septa dividing the somites, are longitudinal. They form irregular masses beneath the epidermis and are almost lacking at the margins of the body (fig. 5). Lying amongst the muscle fibres and scattered in the connective tissue are a number of very irregular, large, pigment cells containing a highly refractive, granular substance. Minute capillary vessels of the coelomic system form an intricate network among the superficial layers of the body wall, and the larger collecting sinuses with which these ultimately communicate, lie in the deeper layers.

The main coelomic spaces are four in number, dorsal, ventral, and lateral. The largest is the ventral sinus (fig. 4, 5, 8), in which lie the nerve cord, ventral blood vessel, and the various ducts of the reproductive systems, as well as portions of the alimentary canal, and into which the ciliate funnels of the nephridia open. For the greater part of the body length this space assumes almost the dimensions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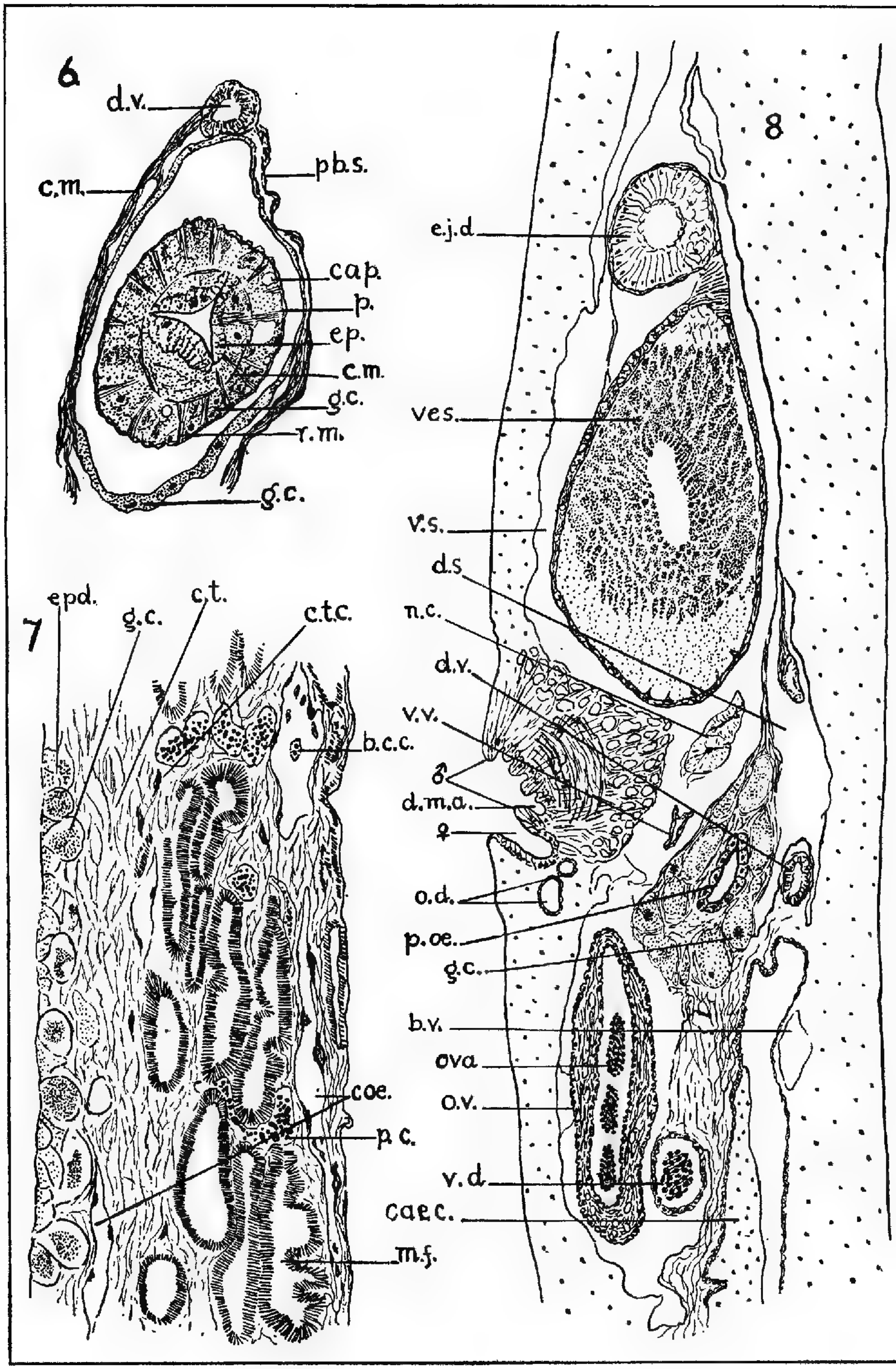
and relationships of an ordinary coelomic cavity. At both extremities of the body the ventral sinus narrows considerably and is lost among the network of fine cavities connecting it with the dorsal and lateral sinuses. The dorsal sinus is much smaller and would be indistinguishable from the larger of the subcutaneous sinuses if it were not for the presence of the thick-walled dorsal vessel within it. It is connected at both ends with the ventral and lateral sinuses by the network of capillaries already mentioned. The lateral sinuses run very close to the margin of the worm, and the body wall above them is composed of the epidermis and a loose parenchyma, but no muscle fibres. These sinuses are dilated somewhat in each segment and give off metamerically-arranged branches (the transverse coelomic spaces) to the ventral sinus. They also receive numerous branches from the subcutaneous system of spaces whose arrangement has already been described in the account of the body wall. Except in the large size of the ventral sinus this arrangement of sinuses closely follows that described by Bourne in *Glossiphonia (ulepsine)*. All these coelomic spaces are lined by an epithelium of large, squamous cells whose nuclei project into the lumen of the sinus. The coelomic corpuscles are small, usually rounded and often binucleate (fig. 7).

Closely connected with the sinus system are the so-called blood vessels. There are two main trunks, dorsal and ventral, lying in the corresponding sinuses and connected at both ends by a series of capillaries indistinguishable from those of the sinus system. The dorsal vessel is strongly muscular and lies immediately above the alimentary canal (fig. 5, 6, 8). The ventral vessel is larger, thin-walled, and lies just above, and usually close to, the nerve cord.

The alimentary canal has the same general arrangement as is present in other members of the genus. There are a retractile proboscis, an oesophagus, a crop with seven pairs of diverticula, and an intestine. The proboscis sheath is lined by a layer of squamous cells continuous with those of the epidermis and, like them, often granular, showing their glandular function (fig. 6). Outside this is a layer of loose muscular tissue whose fibres are more or less circular, and in which the thick-walled dorsal blood vessel is present. This, in turn, is surrounded by the ventral coelomic sinus. The lumen of the proboscis is trifid in transverse section, and is lined by an irregular columnar epithelium. The muscles of the proboscis consist of a very thin sheet of circular fibres and a number of radial fibres with which are interspersed groups of granular secreting cells. In a whole preparation these radial fibres and the gland cells are seen to be quite regularly arranged, giving the peculiar appearance shown in fig. 15. The epithelium surrounding these structures is squamous, like that of the sheath. A very fine cuticle was observed in places, lining the lumen of the proboscis and of the sheath, and covering the former. Towards the base of the organ the structure of its wall becomes rather looser, and the gland cells stain more deeply with eosin. At the base of the proboscis a thin-walled portion of the alimentary canal receives the ducts of the oesophageal glands, and may be termed the anterior region of the oesophagus. This forms loose coils when the proboscis is retracted, but is probably drawn taut by its extension. The posterior region of the oesophagus is lined by a columnar epithelium, similar to that of the anterior part and surrounded by large glandular cells with peculiar and very obvious nuclei (fig. 8). The stomach or crop follows upon the oesophagus in somite 12 and with its diverticula occupies the greater part of the body from somite 11 to the base of the posterior sucker. The form of these structures may be seen in fig. 1. The stomach passes into the intestine at somite 19. The latter is lined by a glandular, columnar epithelium and bears four segementally arranged caeca whose epithelium is of a similar type. At somite 24, the intestine opens by a sphincter into the anterior swollen portion of the thin-walled hind gut. The narrow rectum opens by the anus in the centre of the posterior sucker.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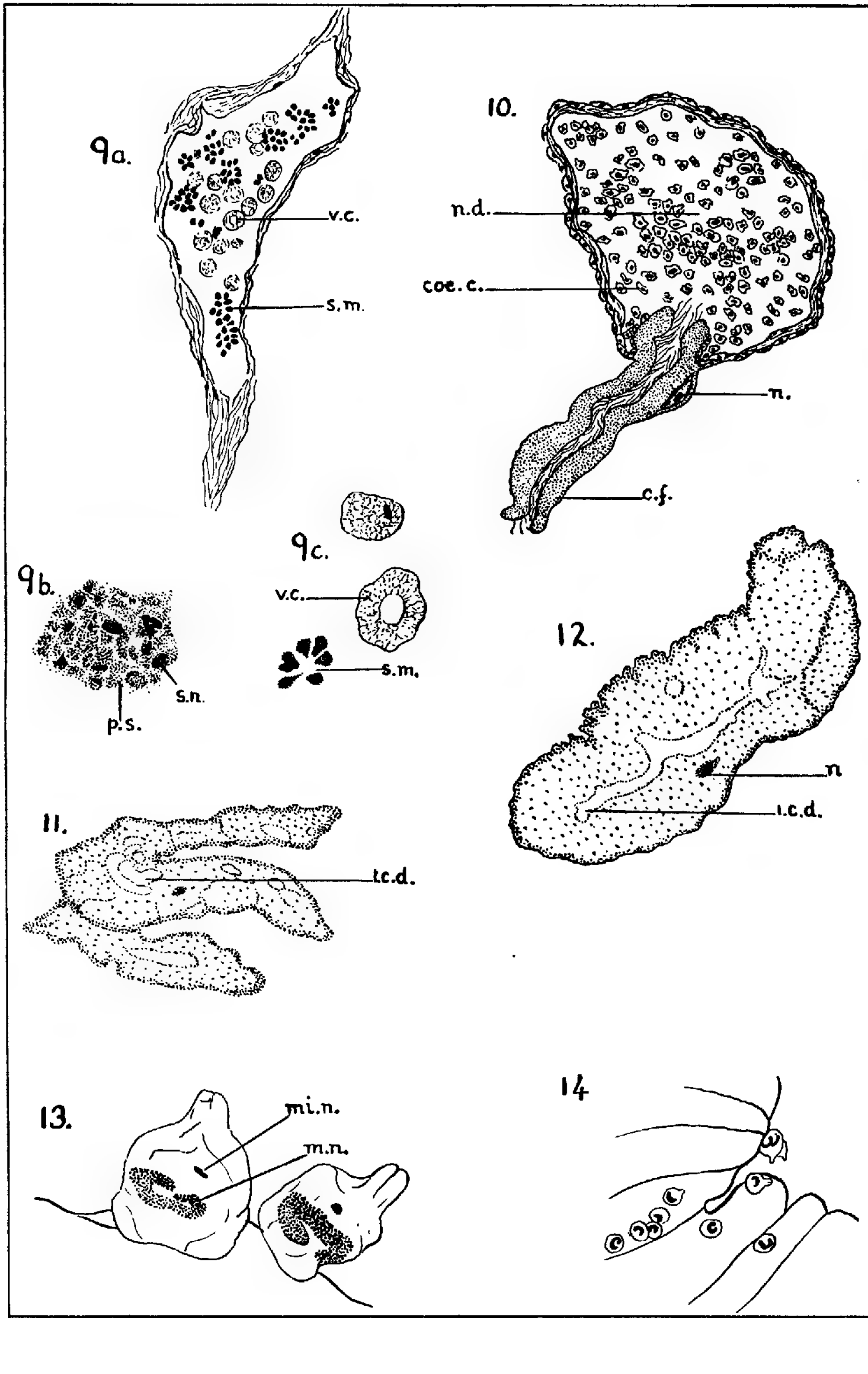
The oesophageal glands are a pair of conspicuous, compact, triangular organs lying in somites 8 and 9. The cells composing them are large, with densely granular protoplasm which stains deeply with eosin. The nuclei are rather small and are situated against the outer boundary of the organ. The cells are pyriform and their tapered ends unite to form the duct of the gland, so that the constituent cells retain their individual connection with the oesophagus in spite of the compact nature of the gland.

There are six pairs of testes, situated between the crop diverticula in somites 13/14 to 18/19. From each testis a thin-walled vas efferens unites with the vas deferens of its own side. This duct passes forward within the ventral sinus and median to the ovary where this is present. Each vas efferens runs side by side with the vas deferens for some distance, eventually joining it at about the level of the preceding testis. In somites 10 and 11, the vas deferens of each side is thrown into coils within the space median to the anterior caeca of the stomach. This coiled ejaculatory duct passes anteriorly into a large club-shaped vesicula seminalis on each side of somite 10. These organs extend posteriorly to the boundary of the annulus containing the male aperture, and are 1 mm. in length and ·04 mm. in their greatest diameter. The wall of the vesicula is composed of an outer layer of circular muscle continuous with that of the ejaculatory duct and an inner zone of very large cells, clear towards their outer extremities and very granular towards the lumen of the organ. At the narrow anterior end these cells merge into the clear, tall columnar epithelium of the ejaculatory region of the vas. The nuclei of the secreting cells are small and close to the muscular coat. The lumen of the vesicula is irregular, the tapered distal portion of each secreting cell projecting into it in the form of a minute papilla (fig. 8). This arrangement is doubtless connected with the formation of spermatophores within the organ. The two vesiculae seminales unite near the midline, below the ventral nerve cord, to form a short muscular common duct opening at the male aperture. Below this duct is a small blindly-ending depression lined with columnar epidermal cells similar to those covering the immediate neighbourhood of the genital apertures, and opening at the male pore. In the sectioned specimen male activity was apparently nearly past. The testicular sacs contained only a few scattered sperm morulae and a number of large cells with a reticular or highly vacuolate protoplasm. On the other hand, the portions of the male ducts contained within the ventral sinus, both vas deferens and vasa efferentia, were swollen with masses of sperms embedded in some sort of prostate secretion. The histological form of these various cells is shown in fig. 9a, b, c.

The ovisacs apparently vary considerably in size according to the sexual condition of the individual. In one specimen examined as a whole mount they extended very little behind the ganglion of somite 12, whereas in the material sectioned they reached somite 16 posteriorly and showed, in addition, an anterior caecum which extended into somite 10. The structure of the wall of the ovisac varies little in its entire length. Both within and without there is a squamous epithelium which may be thrown into small folds. The main thickness of the tube consists of a layer of very small muscle fibres in a connective tissue matrix. In the neighbourhood of the genital pores these and the fibres of the common male duct approach those of the body wall in size and become indistinguishable from them.

Nephridia are absent from the part of the body anterior to the genital apertures and from the posterior sucker. The nephridial funnel is connected with the ventral sinus and the nephridiopores open ventrally in the median third of the body. The coils of the nephridia extend to the margin of the body just inwardly from the lateral sinus. The ciliate funnel (fig. 10) is long and narrow and lined with very long cilia. Its extremity is bifid, each lobe being further partly sub-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divided into two, and each of these four divisions bears a nucleus. Another nucleus is present at the base of the structure. The funnel projects a little into the dilatation following upon it, and here two smaller nuclei are present. This dilatation takes the form of a large sac whose walls are formed of a single layer of cells surrounding a fibrous capsule. Its lumen is filled with coelomic corpuscles. The tubules of the nephridium extend outward to the margin of the body and then return to open by the nephridiopore just ventral to the ciliate funnel and a little behind it. Typical cells of this nephridial tissue, with their intracellular ducts, are shown in figs. 11, 12. The ciliate funnels lie just in advance of the ganglion in the somite which contains them. In all these respects the nephridia resemble those of other members of the same family fairly closely.

The central nervous system has the general character described in detail by Hemmingway for *Placobdella pediculata*. The highly organised eyes lie well beneath the surface on the third annulus. Each consists of a cup-shaped mass of pigment of the same type as that contained in the ordinary pigment cells of the body wall, which are in this region very numerous (figs. 17, 18). The cup is filled with clear cells of the usual type, but no axial fibres were observed. The front of the cup is filled by a mass of cells reaching the surface of the body at one point and extending slightly beyond the limits of the pigment layer. The nuclei of these cells are seen in section to be situated round the periphery of the mass which is enclosed in a distinct capsule. The protoplasm of these rod-like cells is finely granular. They are homologous with the "tactile cells" described by Whitman, but appear to be more specialised as an optical medium than any studied by him, judging from Miss Merrill's summary of his work. In the present species these cells form a distinct, clear cornea-like structure, filling the space between the cells of the optic cup and the surface. The nuclei of these "tactile cells" differ from those of similar cells of the marginal sense organs in the more open nature of their chromatin network.

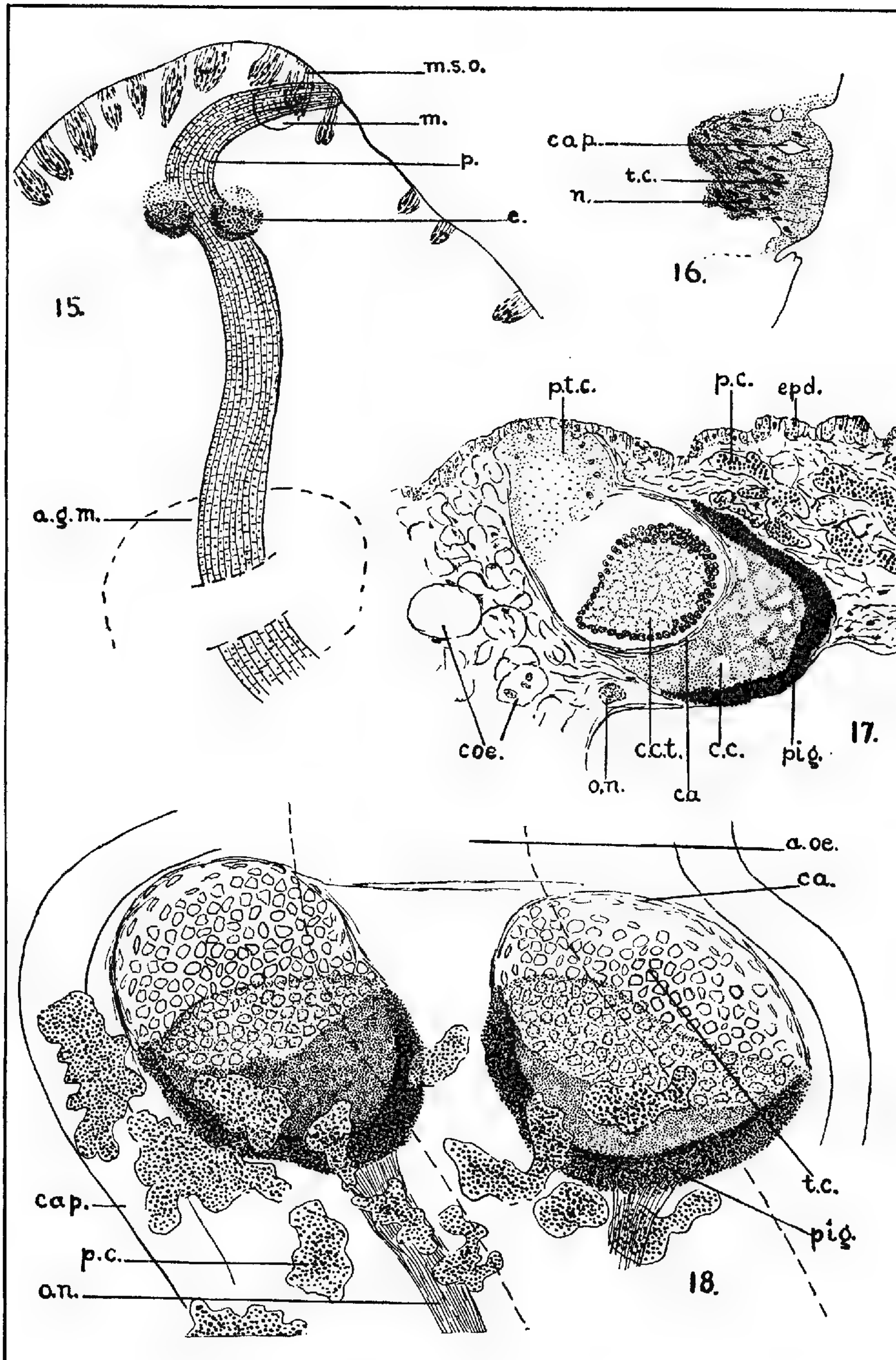
Segmental sense organs or sensillae of the usual type were not observed, but the anterior margin of the body is bordered by marginal sense organs. These take the form of groups of rod-like sensory or tactile cells whose protoplasm is densely packed with fine granules and whose nuclei are spindle-shaped. Capillary vessels occur among the sensory cells.

Attached to one of the specimens were many solitary, peritrichous ciliates, collected along the edges of any depression on the surface. Their form is shown in figs. 13, 14.

The new species of leech has all the characters of the genus *Helobdella* R. Blanchard, 1896 (Glossiphoniidae), and the name *H. bancrofti* is proposed for it in recognition of assistance rendered by Dr. T. L. Bancroft. Its most obvious specific characters are the absence of a dorsal scute, the very compact nature of the oesophageal glands, and the small size of the intestinal caeca.

This appears to be the first record of a member of this genus from Australia, though Goddard (1908-9) described several species of the related genus *Glossiphonia.*

The type slide is being deposited in the South Australian Museum.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LIST OF FIGURES.

All the transverse sections are somewhat oblique.

EXPLANATION OF LETTERING.

a.g.m., anterior ganglionic mass; a.oe., anterior region of oesophagus; b., vertebrate blood in crop; b.c.c., binucleate coelomic corpuscle; b.v., blood vessel; ca., capsule surrounding corneal cells; caec., caecum of crop; cap., capillary; c.c., clear cells; c.c.t., corneal cells, "tactile"; c.f., ciliate funnel; c.m., circular muscle; coe., coelomic space; coe.c., coelomic corpuscle; c.t., connective tissue; c.t.c., connective tissue corpuscle; d., duct; d.m.a., depression below male aperture; d.s., dorsal coelomic sinus; d.v., dorsal vessel; e., eye; ej.d., ejaculatory duct; ep., epithelium; epd., epidermis; g.c., gland cell; i., intestine; i.c., intestinal caecum; i.c.d., intra-cellular duct; l.m., longitudinal muscle; l.s., lateral coelomic sinus; m., mouth; m.f., muscle fibre; mi.n., micronucleus; m.l., muscular layer; m.n., meganucleus; m.s.o., marginal sense organ; n., nucleus; n.c., nerve cord; n.d., nephridial dilatation; o.d., oviduct; oe.d., duct of oesophageal gland; oe.g., oesophageal gland; o.n., optic nerve; ov., ovisac; ova., mass of developing ova in ovisac; p., proboscis; pb.s., proboscis sheath; p.c., pigment cell; pig., pigment cup; p.oe., posterior region of oesophagus; p.s., prostate secretion; p.t.c., prolongation of corneal cells ("tactile") towards surface (cut obliquely); r.m., radial muscle; s.m., sperm morula; s.n., sperm nucleus; t.c., tactile cell; t.v.c., transverse coelomic space; v.c., vacuolate cell; v.d., vas deferens; v.e., vas efferens; ves., vesicula seminalis; v.s., ventral coelomic sinus; v.v., ventral vessel.

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GEOLOGICAL NOTES ON THE ILIAURA COUNTRY NORTH-EAST OF THE MACDONNELL RANGE, CENTRAL AUSTRALIA

BY NORMAN B. TINDALE, SOUTH AUSTRALIA MUSEUM

Summary

During the combined Adelaide University and Museum Anthropological Expedition to MacDonald Downs, August-September, 1930, some notes were made on the geology of the country forming the headwaters of the Mubunji (Bundey) Creek and its tributaries, the Abmoara (Fraser), Alpara, and Irukaru Creeks.

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By NORMAN B. TINDALE, South Australian Museum.

[Read June 11, 1931.]

During the combined Adelaide University and Museum Anthropological Expedition to MacDonald Downs, August-September, 1930, some notes were made on the geology of the country forming the headwaters of the Mubunji (Bundey) Creek and its tributaries, the Abmoara (Fraser), Alpara, and Irukaru Creeks.

The outward journey from Alice Springs was made by means of motor trucks, and followed a new track on the northern side of the MacDonnell Range, *via* Bird and Turner Wells, South Point, Ilarndanga (Kerr's Station), Tjeruka (Peaked Hill), and down the Abmoara Creek to Lilatara (135° 9′ east long. x 22° 25′ south lat.), at the junction of Abmoara and Alpara Creeks, where the head station of MacDonald Downs (owned by Mr. C. O. Chalmers) is situated. The outward journey did not afford many opportunities for detailed observations, but on the return trip, which was made by a different route *via* Ilarndanga, the Upper Mubunji, Table Hill, Hart's Range, Arltunga, and thence by the main track through Undoolya to the Alice, several short detours were made to points of interest in the area herein discussed.

During our three weeks' sojourn, the localities examined included the vicinity of Lilatara; Undala or Bundey Gap, six miles north; Arapia, eight miles north; India Range, three miles south; Ataparapara (Mount Ultim), twelve miles east by south; Mopunja Range, eight miles south-west of Mount Ultim; also Table Hill and its vicinity.

The Alpara Creek rises near Mount Swan and follows first a north-easterly and then a northern course to Lilatara (*lila,* creek; *tara,* two), where it joins the Abmoara. On the present official maps it is wrongly shown as a tributary of the Apewunga (Plenty) River, which has its source near the Hart Range, and flows eastward and then somewhat more southward past the Jervois Range.

Irukaru Creek has its sources in the gently undulating plateau country south-west of Mount Ultim and, after skirting the western flanks of the latter, enters the Mubunji (Bundey) at Undala.

The Alarinjela (Marshall River) has one of its sources on the southern side of Mount Ultim, and flows south-eastward past Atnoala Springs, to join the Apewunja River. The low plateau between the Alarinjela and Irukaru is, therefore, on the north-south divide of the MacDonnell Range, which has hitherto been placed much too far to the north-west. Mistake Creek rises on the eastern flank of Mount Ultim and flows east, and then north, to the Sandover. Apparently no previous description of the geology of the area has been published. The country further east was examined by Brown (1), who approached it by a southern route *via* Arltunga and the lower reaches of the Plenty River.

The MacDonnell Range Pre-Cambrian complex underlies the area at no great depth. Gneisses, schists, with both acid and basic igneous rocks, are present.

At Mopunja Range (fig. 2) these rocks form an extensive peneplain emerging from a mantle of sediments. At this place three small outcrops of basic igneous rocks have been extensively worked by aborigines for the manufacture of stone axes.

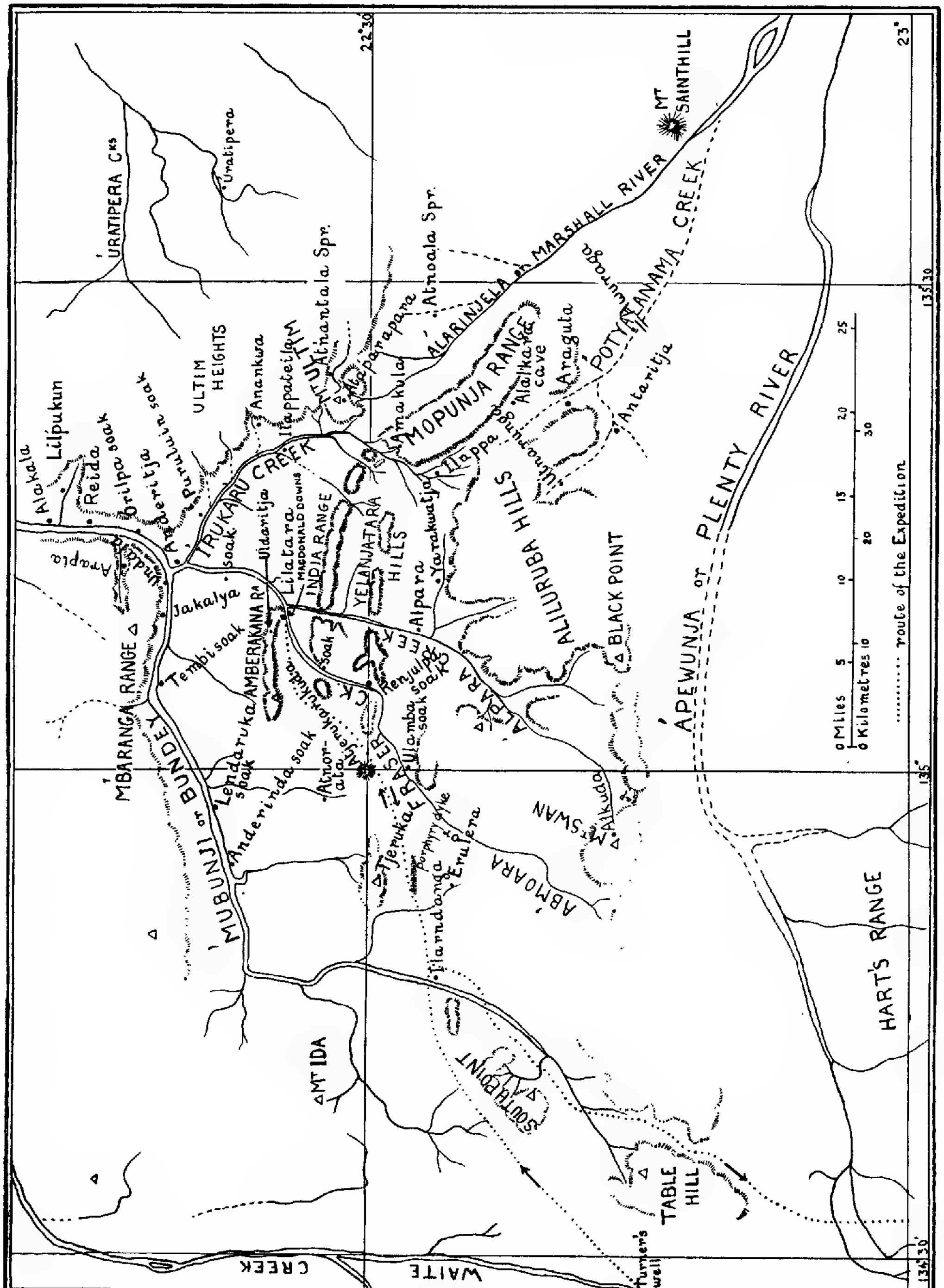


Fig. 1.

Sketch Map of the Iliaura Country, North-east of MacDonnell Range, Central Australia.

Several vertical dykes of coarse granite-porphyry run east and west across the country on the Pre-Cambrian plateau south of Peaked Hill. This plateau extends eastward from Ilarndanga (Kerr's Station), for about twelve miles, to within a mile of Atjerukarukuda Rock, a characteristic outcrop of weathered granite rising a hundred feet from the alluvial plain. Further south the Old

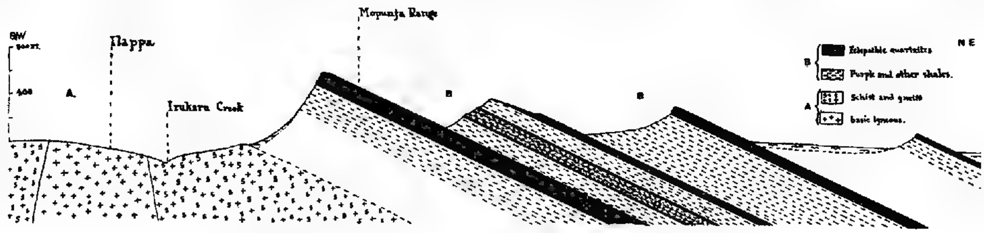


Fig. 2.
Sketch Section at Mopunja Range (c. 2 miles).

Rocks are concealed by limestone and chalcedony beds which form low table-topped hills. Still further south they reappear in the area dissected by the head-waters of the Apewunja River.

Lying directly on the Pre-Cambrian gneisses and schists at Mopunja Range is an extensive sedimentary series, consisting in the main of shales and quartzites (fig. 2). These beds dip at an angle of about 25° to the east-north-east, presenting

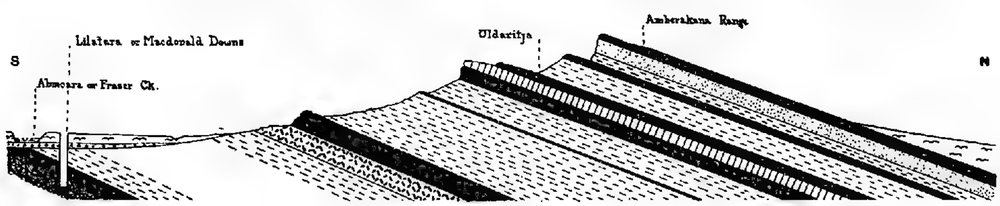


Fig. 3.
Sketch Section, Abmoara Creek to Amberakana Range (¾ mile).

on their western aspect a steep quartzite scarp and a slope estimated to be seven hundred feet in height.

Further to the south the strike of these beds sweeps to the east in an even curve, while to the north-west the strike turns gradually to the west, so that at Lilatara similar beds dip a little east of north.

At India Range, which runs almost due east and west, sections of beds which appear to be somewhat higher up in the Mopunja Range series are met with (fig. 4). The beds dip at about 20° to the north-north-east. They consist of

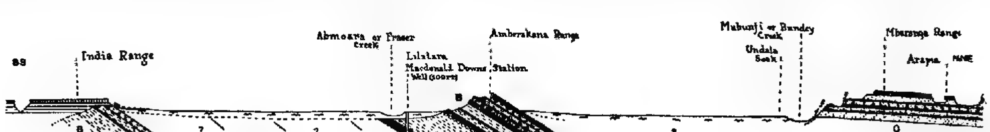


Fig. 4.
Sketch Section, India Range to Bundey Gap (10 miles).

alternating quartzites (sometimes very fine grained, but usually coarse and felspathic) and altered shales containing abundant large flakes of detrital mica. West of the gap (three-quarters of a mile wide) through which the Alpara Creek passes,

the Mopunja Beds are overlain by horizontally-bedded limestones capped with chalcedony. The unconformity is well revealed in a series of small side valleys.

Three miles north of this gap, across an alluvial plain strewn with chalcedony gibbers derived from the breaking down of the limestone plateau, a further section of the Mopunja Beds is revealed at Lilatara (figs. 3, 4). The well on the bank of the Abmoara Creek (in which good water was struck in a coarse felspathic grit at 90 feet) revealed some of the features underlying this plain:—

			Feet.
Horizontal Beds.	Red soil	to	10
	Cemented grit with white chalcedony pebbles	,,	18
	Limestone	,,	20

			Feet.
Beds Dipping c. 20° to North.	Purple and yellow shales	to	64
	Coarse red siliceous sandstone	,,	77
	Shale	,,	78
	Felspathic grit	,,	90

Purple shales similar to those present in the well outcrop at the base of Uldaritja Hill, several hundred yards to the north-west, and are conformable with alternating thin quartzites and shales, with some fine conglomerates. These beds may be enumerated here, in descending order (with approximate thicknesses), as being typical of the Mopunja series as a whole:—

Coarse felspathic quartzite	10
Coarse quartz grit	15
White shale	10
Coarse felspathic quartzite	5
Purple shales	30
Coarse felspathic quartzite	5
Fine quartzite	10
Coarse felspathic quartzite	15
Shales with a thin quartzite and some argillaceous sandstone	90
Coarse felspathic quartzite	20
Coarse iron-stained grit or fine conglomerates with unabraded fragments of crystalline constituents	20
Purple shales	?

The shales everywhere show signs of disturbance, and the felspathic quartzites are permeated by polished slickenslide faces. The aborigines naively account for the latter by saying that some mythical ancestors milled grass seeds upon the rocks.

Looking northward from Mopunja, and from Lilatara, across an alluvial plain about five miles wide, there can be seen a series of almost horizontally-bedded sediments (of different character from those already described) which extend for some twenty miles across the northern horizon. These beds consist of bright red sandstones and fine quartzites, together with a few argillaceous sandstone horizons. They dip at a low angle (about 3-5°) to the north-north-east, and by their character indicate that they are of littoral origin. Current-bedded and ripple-marked sandstones are well developed, together with numerous fossil beds. In character and content they stand in marked contrast to the beds of the Mopunja series, and, therefore, it is suggested that an unconformity may be discovered between them.

Between Undala and Mount Ultim these sandstones form a plateau sloping gently to the north; it stands four to eight hundred feet above the plain. The south-western margin of this plateau forms a steep scarp and slope, only slightly cut into by a series of small valleys at regular intervals along its margin. Upon

the top of the plateau there is a series of smaller flat-topped residuals (culminating in Mount Ultim itself) which have resisted weathering. North of Undala this plateau dips gradually towards the vast Sandover Plain.

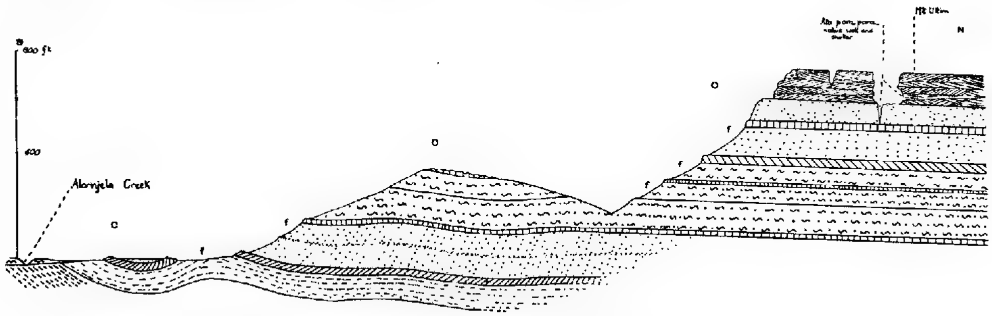


Fig. 5.
Sketch Section, from Alarinjela Creek to Mount Ultim (2 miles).

The first observations on these beds were made at Arapia and at Undala, where fossils, in the form of "worm-tracks" and ? *Orthoceras* casts were discovered, but, as the same horizons were afterwards identified and examined in detail at Mount Ultim, the latter occurrence will be described in preference.

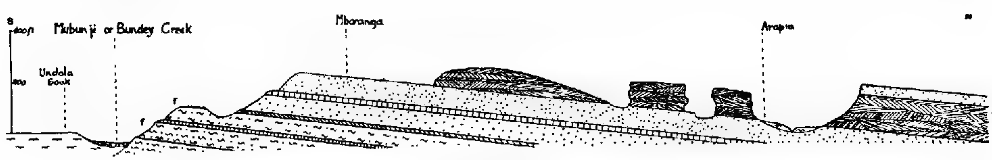


Fig. 6.
Sketch Section, from Undala to Arapia (c. 2 miles).

The Mount Ultim occurrence consists of a thickness of about 800 feet of sediments (fig. 5) which, in descending order, consist of:—

	Feet
Current-bedded Sandstone .. .. approx.	100
Massive red sandstone .. .. ,,	80
White quartzite with an *Orthoceras* horizon at its base ,,	20
Red sandstone with *Raphistoma* .. .. ,,	100
Current-bedded gritty quartzite .. .. ,,	30
Argillaceous sandstone with "worm-tracks" and ripple-marks .. .. ,,	50
Fine Quartzite .. .. ,,	10
Red sandstone with "worm-tracks" and ripple-marks .. ,,	60
Quartzite .. .. ,,	c.5
White argillaceous sandstone with fossils .. .. ,,	100
Quartzite .. .. ,,	10
Argillaceous sandstone .. .. ,,	120
Highly crystalline quartzite .. .. ,,	20
Grey argillaceous sandstone with fossils .. .. ,,	100
Shale .. .. ,,	?

The current-bedded quartzite forming the summit of Mount Ultim is weathered into numerous shallow caverns and leaning rock-shelters, which have been made use of by aborigines. The mode of weathering is so characteristic a

feature of this bed wherever it outcrops that the natives have a rational explanation for the occurrence, which takes the form of a legend explaining how a mythical being commenced shelter-making operations many miles to the west and proceeding south-eastward, excavated shelters in turn at Arapia, Mount Ultim, Mistake Creek, etc.

At Undala (fig. 6) a bed which was identified with "fine quartzite" of the Mount Ultim series forms a smooth flat surface, upon which the natives have cut a few simple figures. Above and below it there are, as at Mount Ultim, red

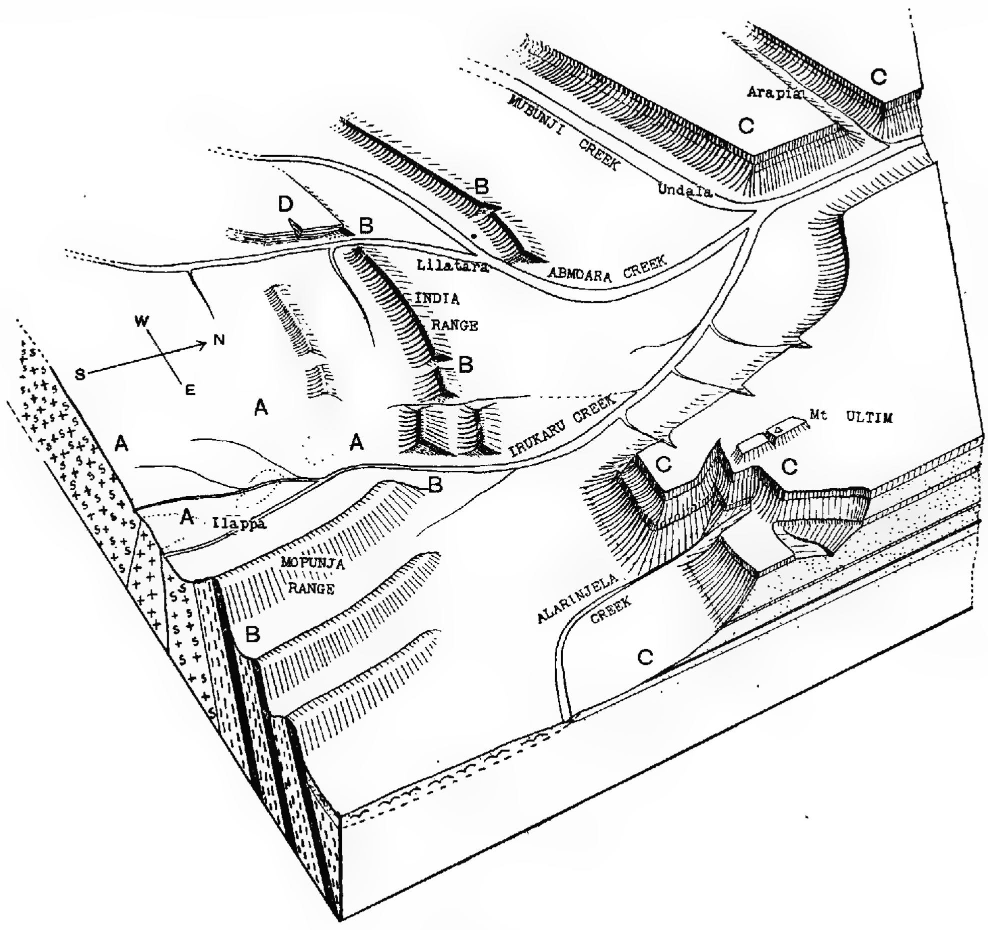


Fig. 7.
Block diagram of the vicinity of Lilatara.

sandstone beds with abundant "worm-tracks." Many of the boulders also show fine ripple marks. Beds lower in the series do not outcrop.

North of Arapia the current-bedded sandstone, corresponding to the beds forming the summit of Mount Ultim, are capped by silicified sandstone. Further to the north the beds appear to dip at a low angle towards the alluvial sediments of the Sandover. Limestone beds, capped by chalcedony, are stated to occur further to the north, but were not examined.

A representative series of fossils from these beds has been lodged in the Palaeontological Collection of the S.A. Museum, and it is hoped that their identification will be soon carried out.

Several references have been made to the occurrences of limestone beds capped by chalcedony. At India Hill they lie unconformably on the Mopunja series (fig. 4), while according to Mr. C. O. Chalmers similar beds to these occur north of Arapia. At the first-named place the beds in descending order were observed to be:—

	Feet
Chalcedony	6
Limestone	6-20
Kaolin	10
Red ferrugineous grit	?

In the whole of the south-eastern part of the area under discussion and around Table Hill and South Point this formation has given rise to a partly dissected plateau, traces of which can be seen in the form of table-topped hills up to one hundred feet in height. The breaking up of this extensive formation has also given rise to the larger or smaller chalcedony gibbers which everywhere strew the alluvial plains and, as coarse grit or gravel, helps to choke the wide sandy beds of the creeks.

SUMMARY.

Representatives of what appear to be three, possibly four, geological series (fig. 7) have been noticed:—

A. Pre-Cambrian gneiss, schist, with granitic and basic intrusions.

B. Mopunja Range series of coarse felspathic quartzites and purple shales resting upon a peneplaned Pre-Cambrian pavement.

These beds have a general dip of about 20°-25° to the north-east; the strike varying from north to east and then back to north as one travels from east to west.

C. Almost horizontal red sandstones, fine-grained quartzites, and some argillaceous beds, littoral in character and containing numerous fossils, which suggest a tentative "Ordovician" age for the beds.

D. Younger limestone series of thin horizontal beds capped by chalcedony, found resting unconformably on sediments of the Mopunja Range type.

In the accompanying block diagram (fig. 7) the relationships of the four series are set out in a simplified manner.

ACKNOWLEDGEMENTS.

We are indebted to Dr. C. Chewings, who suggested that these notes should be placed on record, and to the members of the Expedition, especially to Dr. H. K. Fry, who was particularly interested in the geology, and to Prof. T. Harvey Johnston, who located the "*Orthoceras*" horizon at Mount Ultim. Mr. C. O. Chalmers provided native guides and horses, and thus enabled us to visit several otherwise inaccessible spots. Finally, we are indebted to an Iliaura native, Akoambaka by name, who on our first arrival in the district explained the principal details of the physiography of his country by means of a relief map, voluntarily constructed in the sand of the creek bed.

REFERENCE.

1. BROWN, H. Y. L.: "Reports on Arltunga Goldfield . . . and Explorations North-east of Hart's Range, in South Australia." Parliamentary Papers, No. 1,353, Adelaide, 1897, pp. 5-8, and map No. 2.

NOTES ON SOME MISCELLANEOUS COLEOPTERA, WITH DESCRIPTIONS OF NEW SPECIES. PART VIII

BY ARTHUR M. LEA, F.E.S.

Summary

The transverse arrangement of the prothoracic granules, often so exaggerated that the prothorax appears traversed by fine carinae, is a very distinctive feature of many species of the genus, and easily recognisable, although abrasion is sometimes necessary to see it. In the 1926 key, a special section, "G," was given for fourteen of them. Other species not previously referred to "G," but with transverse arrangement, are: *M.* canalicornis, n. sp., contortus, n. sp,, excavatus Lea, ferrugineus Lea, incisipes, n. sp., medianus, n. sp., melancholicus, n. sp., octagonalis Oke, and valgus Pasc.

NOTES ON SOME MISCELLANEOUS COLEOPTERA, WITH DESCRIPTIONS OF NEW SPECIES. PART VIII.

By Arthur M. Lea, F.E.S.
(Contribution from the South Australian Museum.)

[Read July 9, 1931.]

Family CURCULIONIDAE.

Mandalotus.

Since the key given in the Records of the South Australian Museum, on March 31, 1926, species of this genus have been dealt with as follows:—

1927. Lea, Proc. Linn. Soc., N.S.W., pp. 356-357.
1929. *L.c.*, pp. 528-533.
1931. Oke, Proc. Roy. Soc., Vic., pp. 181-190.

The species there dealt with, and the new ones described in the following pages, may be associated with the key in the following positions:—

B.	*pentagonoderes* Lea	G, *qq.*	*medianus*, n. sp.
C, *ddd.*	*leai* Oke, and *parentheticus*, n. sp.	G, *t.*	*canalicornis*, n. sp
		G, *u.*	*corrugicollis* Lea
C, *h.*	*sternocerus* Lea	G, *v.*	*melancholicus*, n. sp.
C, *n.*	*dolens* Lea	H.	*goudiei*, n. sp.
D, *zz.*	*insignis*, n. sp.	I (or NN, *v*)	*femoralis* Lea
DD, *e.*	*rufipes* Lea	J, *m.*	*minusculus* Oke
DD, *eee.*	*egenus* Oke	J, *pp.*	*granicollis*, n. sp.
DD, *nnn.*	*fimbriatus* Lea	K (or YY)	*villosipes* Lea
DD, *r.*	*explanicollis* Oke	NN (or NNN)	*oculivorus*, n. sp.
F, *dd.*	*tuberipennis* Lea	NNN.	*modicus*, n. sp.
F, *l.*	*armicoxis* Lea	O.	*acanthocnemis* Lea, and *bryophilus* Oke
F, *m* (or NN, *ww*)	*octagonalis* Oke		
G, *q.*	*contortus*, n. sp. and *incisipes*, n. sp.	W.	*cinereus*, n. sp.

This leaves two species (excluding synonyms and others transferred to *Timareta)* for which no positions have yet been suggested, as their types are females.

M. imponderosus Lea. A minute species (1·5 mm.), from Queensland.

M. latus Lea. A wide, tuberculate, densely clothed species, from Tasmania.

The transverse arrangement of the prothoracic granules, often so exaggerated that the prothorax appears traversed by fine carinae, is a very distinctive feature of many species of the genus, and easily recognisable, although abrasion is sometimes necessary to see it. In the 1926 key, a special section, "G." was given for fourteen of them. Other species not previously referred to "G," but with transverse arrangement, are: *M. canalicornis*, n. sp., *contortus*, n. sp., *excavatus* Lea, *ferrugineus* Lea, *incisipes*, n. sp., *medianus*, n. sp., *melancholicus*, n. sp., *octagonalis* Oke, and *valgus* Pasc.

On fairly numerous species the middle coxae are armed, although to see the armature clearly it is sometimes necessary to twist the leg, or to view it from several angles, and a small amount of grease or dirt may easily obscure it.

On several species there is a shining ridge, but not a dentiform process. The species so armed, owing to the exigencies of tabulation, were not all associated together in the key. The following are also so armed:—*M. contortus*, n. sp., *ferrugineus* Lea, *dentipes* Lea, *medcoxalis* Lea, *medianus*, Lea, *octagonalis* Oke, *oculivorus*, n. sp., *oxyomus* Lea, (more a ridge than a tooth), and *valgus* Pasc.

I do not think the femora in any of the species could fairly be regarded as dentate, the apical incurvature in several species, from certain points of view, appears sudden, but the part before it is rather the abrupt termination of a swelling than a distinct tooth, and clothing may also cause deceptive resemblance to dentition. Although in figure 3 (especially on C and H) Mr. Oke has shown quite strong teeth, he nowhere mentions femoral dentition in his descriptions.

The tibiae are very distinctive on the males of many species, but it is usually necessary to examine them from several points of view, or even to detach them from the body (in the case of species with the inner side distinctive), to see their structure clearly; clothing and dried mud are also apt to disguise their features; so in the sketches given no clothing was shown.

In sending specimens of *M. goudiei*, Mr. Goudie called my attention to the fact that each of its claw-joints was apparently terminated by a single claw; this at first appears to be the case, but on close examination it may be seen that there are really two claws, very closely applied together; and they are very similar to those of the other species (H of the key) with the scape very thick (except in *M. nodicollis*, on which the claws are normal), *viz. M. ammophilus, crassicornis, herbivorus* and *pondericornis*. This character was previously overlooked, except that for *ammophilus* it was noted: "Claws subsoldered together at base." On *M. howensis*, with a heavy scape, although less heavy than on the species of H, the claws are also approximate. On *M. acutangulus*, on which the scape is stouter than on most species, other than those of H, the claws are normal.

Mandalotus parentheticus, n. sp.

♂. Dark brown, antennae and tarsi paler, some parts obscurely darker. Densely clothed with dull brown and grey scales, becoming almost uniformly pale grey on under parts; in addition with stout and usually curved setae, on the elytra confined to a regular row on each interstice.

Rostrum with median carina normally concealed. Antennae moderately long. Prothorax moderately transverse, sides strongly rounded, derm concealed. Elytra subcordate, shoulders rounded, base wider than prothorax, interstices even except for feeble alternate elevation; punctures large, but appearing much smaller through clothing. Intercoxal process of mesosternum small, but obtusely conical. Metasternum very short. Basal segments of abdomen flattened in middle. Legs moderately long, front coxae touching. Length, 3·5-3·8 mm.

♀. Differs in being slightly more robust, intercoxal process of mesosternum unarmed, abdomen more convex, and legs slightly shorter.

Australia (Dr. W. Horn).

By the upper surface practically indistinguishable from *M. blackmorei*, but the mesosternum armed in the male, and both sexes distinct from those of that species by the front coxae in contact. The intercoxal process of the prosternum is but little produced, and is obtusely pointed, but in the key the species could only be placed in C, *ddd*, and associated with *M. vacillans*, in which the process is also rather feeble; but on that species the front coxae are distinctly, although not widely, separated. The clothing is also different, although not much reliance is to be placed on this. Both specimens have the derm brownish or castaneous, as may be seen where slight abrasions have occurred; the only parts that are apparently black are on the head. The scales on the prothorax are mostly pale, with five distinct dark lines from base to apex, the median straight, the others evenly

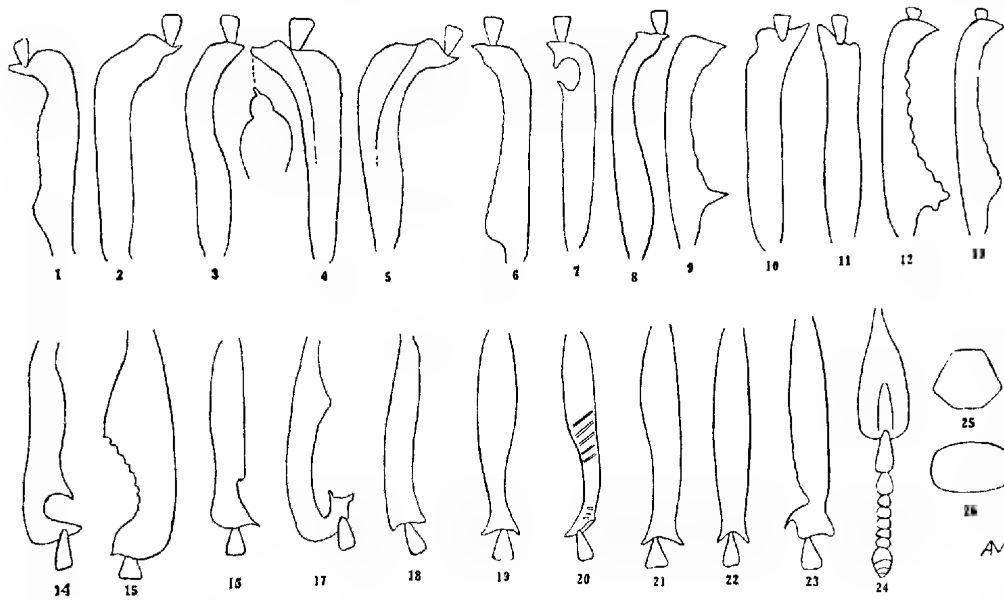
curved (less distinct on the female than on the male); on the elytra the paler scales are in the minority, and are irregularly distributed. The derm of the pronotum is entirely concealed, but feeble granules are indicated. There are no striking features on the legs, the right front tibia of the male has a minute denticle near the base, but it is not present on the left one.

Mandalotus insignis, n. sp.

Figs. 1, 14, 17, 18.

♂. Black, parts of antennae and tarsi obscurely reddish. Densely clothed with scales and setae.

Rostrum with median carina indicated throughout. Antennae moderately long. Prothorax slightly transverse, sides slightly increasing in width from base to apical third, and then rapidly narrowed to apex; with large, normally concealed granules. Elytra rough, base narrower than widest part of prothorax and unevenly arcuate; with rows of large punctures, distinct on sides, but almost or



EXPLANATION OF FIGURES.

1, front tibia of *Mandalotus insignis* Lea; 2, of *M. contortus* Lea, type; 3-5, of *M. contortus* from Barrington Tops; 6, of *M. melancholicus* Lea; 7, of *M. incisipes* Lea; 8, of *M. medianus* Lea; 9, of *M. acanthocnemis* Lea; 10-11, of *M. pentagonalis* Lea; 12-13, of *M. tibialis* Lea; 14, middle tibia of *M. insignis* Lea; 15, of *M. glaber* Blackb.; 16, of *M. canalicornis* Lea; 17-18, hind tibiae of *M. insignis* Lea; 19-20, of *M. medianus* Lea; 21, of *M. decipiens* Lea; 22-23, of *M. glaber* Blackb.; 24, antenna of *M. canalicornis* Lea; 25, intercoxal process of mesosternum of *M. niger* Lea; 26, variety of same. All without clothing.

quite concealed elsewhere; alternate interstices irregularly elevated, the third and fifth tuberculate. Basal segment of abdomen with a strong subconical tubercle on each side of middle, slightly nearer base than apex. Front coxae widely separated, but not quite as widely as middle ones; front and middle tibiae notched near apex, hind ones strongly bisinuate on lower surface, the apex incurved and bidentate. Length, 6·5-8·0 mm.

♀. Differs in being wider in proportion, elytral tubercles less conspicuous, basal segment of abdomen more convex and non-tuberculate, and tibiae not notched.

New South Wales: Bombala. Types, in Australian Museum.

Remarkably distinct by the bituberculate abdomen and tibiae of the male. In the key could be associated with *M. glaber* and *decipiens*, two polished black species, with very different tibiae. The clothing is so dense that the derm is everywhere concealed, and the type is rather dirty. To the naked eye it appears of a muddy-brown, but on close examination numerous small golden scales may be seen; the setae are numerous, and all the tibiae are fringed with long hairs. The third interstice on each elytron has a fairly large, round tubercle, crowning the apical slope, the fifth has a swelling at the basal third, and then curves outwards, and has three tubercles, one before the one on the third, and two beyond it, there is also a small posthumeral tubercle, invisible from directly above. The pronotum of the female appears to have four feebly elevated tubercles: two in the middle, and two at the base; on the male the two basal ones are very feebly indicated, but not the two median ones.

Mandalotus contortus, n. sp.

Figs. 2-5.

♂. Black, some parts paler, parts of antennae and tarsi obscurely reddish. Densely squamose and setose.

Rostrum with median carina obscured but traceable. Antennae moderately long. Prothorax slightly wider than long, angles rounded off, but sides subparallel in middle; granules conspicuously transversely arranged or subcarinate. Elytra at base narrower than widest part of prothorax, but quite as wide across the posthumeral swellings; with rows of large punctures, partly or entirely concealed by clothing; suture on apical slope, and parts of odd interstices elevated. Metasternum and two basal segments of abdomen widely and shallowly concave. Front coxae widely separated, middle ones each with a conspicuous tooth; front tibiae dilated and suddenly deflected at apex, with an obtuse notch near outer apex, the apex itself acute, middle tibiae strongly arched near apex and acutely pointed, hind tibiae rather strongly curved. Length, 7-9 mm.

♀. Differs in being more robust, elytra less strongly narrowed behind the posthumeral swellings, two basal segments of abdomen gently convex, middle coxae unarmed, front tibiae less suddenly deflected at apex, the other tibiae shorter, and all with shorter clothing.

New South Wales: Ebor (C. F. Deuquet), Barrington Tops (H. J. Carter).

A remarkable species. The prothoracic granules transversely arranged, dentate middle coxae, and front tibiae notched near apex, associate it with *M. dentipes*, from which it differs in being much larger, and elytra rougher. The front tibiae are much wider near apex, the external notch, although distinct, is rather shallow (it is less defined on the type than on the Barrington Tops specimen), and the tip is actually pointed (it is necessary, however, to examine the tibiae from several directions to see these particulars). The general outlines are much as those of *M. niger*, but the legs are very different. Seen from behind, the base of the elytra appears strongly trisinuate, but from directly above it appears almost evenly arched, with the shoulders clasping the base of the prothorax; the third interstice is distinctly elevated near the base, and again beyond the middle, the elevation abruptly terminated at the summit of the apical slope, so as to appear subtuberculate. From one direction the tooth on each middle coxa is seen to be flat, and wider than long, from another it appears as an acute spine. The hind tibiae are shining internally, with transverse granules or short ridges, denoting an approach to the numerous transverse ridges of *M. niger*. The clothing of the type is of a rather light brown, becoming paler on the under surface; on the upper surface there are many pale setae, in the majority on the pronotum, in the minority on the elytra, on the legs they are about evenly divided. The specimen from Barrington Tops has the clothing obscured by dried mud,

and the hairs on the lower part of the front tibiae are compacted, so as to appear to be fasciculate near the apex, its front tibiae are longer and more complicated at the apex (figs. 3-5) than on the type (fig. 2), but it was not made the type on account of its poor condition.

Mandalotus melancholicus, n. sp.

Fig. 6.

♂. Black, parts of antennae and tarsi reddish. Densely clothed with sooty or sooty-brown scales, interspersed with sloping or curved setae; on the elytra almost confined to a single row on each interstice; tibial fringes rather long.

Rostrum with median carina glabrous throughout. Antennae rather long. Prothorax slightly wider than long, sides rounded and widest slightly in advance of the middle, median line well defined; with flattened granules transversely arranged, or altered to short transverse or oblique ridges. Elytra slightly narrower than widest part of prothorax, base trisinuate, posthumeral prominences feeble and scarcely visible from above; with rows of large punctures, appearing much smaller through clothing, alternate interstices slightly raised. Metasternum and basal segment of abdomen rather shallowly depressed. Front coxae decidedly but not very widely separated, the middle ones almost twice as widely; front tibiae multigranulate internally, somewhat dilated towards base, and then suddenly narrowed to base itself, apex acutely pointed. Length, 5·5-6·5 mm.

New South Wales: Armidale (C. F. Deuquet). Two specimens.

The transverse or oblique arrangement of the prothoracic granules is not as pronounced as on the species referred to G, in the key, but regarding it as correctly placed there, it could hardly be associated with *M. abdominalis* (a much smaller and otherwise different species), as the basal segment of abdomen is punctate and clothed; passing that species it could only be associated with *M. crawfordi*, also much smaller and otherwise different. Regarding it as belonging to GG, it differs from *M. foveatus*, in the much less depth of the depression common to the metasternum and abdomen, that species also has quite rounded prothoracic granules; passing it, it could be placed with *M. albonotatus*, which is a smaller species, with very different clothing and granules. It seems better referred to G. The middle coxae could hardly be regarded as ridged, although shining along the middle; they are certainly not armed. On one specimen there is an obscurely pale ring on each femur, and a few pale scales on the under surface, but on the other the clothing is practically uniformly dark throughout. In general appearance it resembles *M. crudus* (with mesosternum armed), *arciferus* and *fimbriatus* (with abdomen carinated), and *piliventris* (with densely clothed abdomen). It is close to *M. corrugicollis*, but the transverse arrangement of the prothoracic granules much less conspicuous; on that species the ridges on the disc are all distinctly wider than the head, whereas on the present one there are many true granules, and no ridge is the width of the head; on the present species also there is an impressed median line, which is absent from *corrugicollis*, the front tibiae are more arched at the apex, and the clothing generally is darker.

Mandalotus incisipes, n. sp.

Fig. 7.

♂. Blackish, parts of antennae and tarsi reddish. Densely clothed with muddy-brown scales and setae, the latter on the elytra almost confined to a row on each interstice.

Rostrum with median carina exposed throughout. Scape rather long and thin (the rest of antennae wanting). Prothorax moderately transverse, sides gently rounded, median line slight; with flattened granules transversely arranged and often elongated. Elytra across posthumeral tubercles (which are rather

obtuse) the width of prothorax; with rows of large punctures, appearing much smaller through clothing; odd interstices slightly elevated. Metasternum and basal segment of abdomen with a rather deep excavation. Front coxae distinctly but not very widely separated, the middle ones each with an acute ridge, but not dentate, and separated more than the front ones, front tibiae suddenly notched near lower apex. Length, 6 mm.

New South Wales: Mittagong, in January (H. J. Carter). Unique.

In the key could be associated with *M. dentipes*, but the notch on the front tibiae is on the lower side of the apex, on that species it is on the upper side.

Mandalotus medianus, n. sp.

Figs. 8, 19, 20.

♂. Blackish, parts of antennae and of legs obscurely reddish. Densely clothed with sooty-brown scales, variegated with stramineous, and interspersed with setae, on the elytra almost confined to a single row on each interstice.

Rostrum with median carina concealed towards base, but exposed in front. Antennae moderately long. Prothorax slightly transverse, sides rather strongly rounded; traversed by numerous fine ridges, becoming granules on sides. Elytra slightly narrower than prothorax, base trisinuate, posthumeral tubercles rather feeble; with rows of large punctures, appearing much smaller through clothing, alternate interstices feebly elevated, the apical slope somewhat rough but not tuberculate. Front coxae widely separated, not much less than the least distance between the middle ones, which are obtusely but fairly strongly dentate; front tibiae rather thin, moderately curved at apex, hind ones longer, shining internally and with transverse ridges across the median third. Length, 5-6 mm.

♀. Differs in being wider in proportion, prothoracic ridges shorter, two basal segments of abdomen gently convex, legs shorter, middle coxae unarmed, and hind tibiae without transverse ridges.

New South Wales (C. F. Deuquet).

In the key could be associated with *M. oxyomus*, from which it is distinct by the transverse ridges on the inner side of the hind tibiae, somewhat as on *M. niger*. It is somewhat like *M. contortus*, on a reduced scale, but the tibiae are very different. The paler scales are uniform on the head, form a distinct spot at the base of the third interstice on each elytron, clothe most of the sides, and form feeble spots on the rest of the upper surface; on the under surface and legs they cover about half the derm. The basal segment of the abdomen of the male is flattened and depressed in middle, the flattened space being almost glabrous, and margined externally by a curved line, extending from the tip of the segment to the middle of the coxa on each side, so that at first glance it appears carinated, although it is not really so. On the female the same space (although gently convex) is similarly bounded.

Mandalotus canalicornis, n. sp.

Figs. 16, 24.

♂. Black, parts of antennae and tarsi reddish. Densely clothed with scales, interspersed with stout setae.

Scape very stout, lower surface grooved on apical third. Prothorax moderately transverse, sides rather strongly rounded, granules transversely arranged and many altered to short ridges. Elytra across middle wider than prothorax, base arcuate, shoulders acutely produced; with rows of large, more or less concealed punctures; the odd interstices slightly elevated. Basal segment of abdomen depressed in middle. Front coxae almost touching, middle tibiae with a slight notch near lower apex, claws distinctly separated. Length, 4-5 mm.

♀. Differs in being slightly more robust, two basal segments of abdomen gently convex, legs slightly shorter, and middle tibiae feebly incurved near lower apex.

New South Wales: Armidale (C. F. Deuquet).

As the prothoracic granules are transversely arranged the species would not go as far as H (the *crassicornis* group) in the key; but in any case distinguished from all of that group by the normally separated claws (except *M. nodicollis*, which is structurally very different), and the transverse arrangement of the granules. Referring it to G, it could be associated with *M. acutangulus*, which has the scape thinner, but heavier than on other species of the genus (except those of H), and the front coxae more distant (about as far apart as the median ones of this species); on this species they are almost in contact. On *M. crawfordi*, *transversus*, and *setosus*, the scape is much thinner. The three specimens taken have the clothing obscured by dried mud, but on scraping some of this away the distinctive sculpture is revealed. The middle tibiae of the male have a slight subapical notch, but it is obscured by the clothing and invisible from most directions.

Mandalotus goudiei, n. sp.

♂. Black, parts of antennae and legs reddish. Densely clothed with sooty scales, with variable whitish or greyish markings, and interspersed with sloping setae, also varying in colour.

Rostrum short, median carina traceable throughout. Scape very stout, except the basal fourth. Prothorax moderately transverse, sides strongly rounded; with numerous round granules traceable through clothing. Elytra subcordate, shoulders rounded, considerably wider than prothorax across middle; with rows of large punctures, appearing much smaller through clothing, or quite concealed; alternate interstices very feebly elevated. Basal segment of abdomen flattened in middle. Front coxae touching, middle fairly close together. Length, 3 mm.

♀. Differs in being slightly more robust, two basal segments of abdomen gently convex, and slightly shorter legs.

Victoria: Black Rock, in May (J. C. Goudie). Numerous specimens obtained by sieving fallen leaves.

The smallest of all the species with heavy scape, and one of the most interesting of the genus. The claws at first appear to be single, but on close examination are seen to be close together (as on most of the species of H, in the key). On several specimens some of the body parts are reddish. The distribution of the paler scales is scarcely alike on any two specimens before me; on the type they cover most of the rostrum, form a distinct line on each side of the prothorax, and a few discal spots, cover about half of the elytra, of which the largest area begins on each shoulder, is obliquely dilated hindwards till it covers most of the apical slope, and cover much of the abdomen (there is a black median vitta on the three apical segments) and legs. On several specimens the shades are much less sharply contrasted, so that the surface appears rather feebly mottled; on several the pale line on each side of the prothorax does not extend the full length, but is sharply defined; the markings in the scutellar region are particularly variable. The intercoxal process of the mesosternum is briefly subconical, but as it is short, and alike on both sexes, the species could not fairly be referred to C, in the key.

Mandalotus granicollis, n. sp.

♂. Black, antennae and legs reddish. Rather densely clothed with brown scales, variegated with grey, and becoming sparse on under surface, most of which is shining; with sparse upright setae, more distinct on elytra than elsewhere; tibiae with rather long hairs on under surface, sparse on the front and middle pairs, denser and longer on hind ones.

Rostrum with median carina distinct only in front. Antennae moderately long. Prothorax slightly transverse, sides rather strongly rounded; with numerous small, shining granules. Elytra widest slightly behind shoulders, where the width is equal to that of prothorax, base evenly curved, without posthumeral tubercles; with rows of punctures, appearing fairly small through clothing; third and fifth interstices wider than the others, but not elevated above them. Basal segment of abdomen rather deeply depressed along middle. Front coxae touching, hind tibiae with a slight notch near outer apex, and several denticles (obscured by clothing) about inner apex. Length, 3·5 mm.

New South Wales: Mount Tomah, in October. Type (unique) in Mr. F. E. Wilson's collection.

The hind tibiae are conspicuously fringed, but as only the male is known, it cannot with certainty be associated with *M. inusitatus*, in which it is fringed in both sexes; it differs from the male of that species in the conspicuous median depression on the basal segment of abdomen, on each side of which there is a swelling (but not a tubercle or carina); passing that species, in the key, the feeble markings of the elytra are not sufficient to associate it with *M. maculatus* and *cordipennis* (two smaller species), passing which it is distinct from *M. gymnogaster* (also with a shining abdomen), *alpinus* and *muscivorus*, by the very different hind tibiae. It is perhaps nearer *muscivorus* than any previously named species. In some lights some of the scales have a faint golden gloss. The prothorax has numerous small shining granules, which apparently are normally without scales.

Mandalotus cinereus, n. sp.

♂. Reddish-brown, some parts almost black, antennae and tarsi paler. Densely clothed with almost uniform white or greyish-white scales, with numerous sloping or suberect setae, on the elytra confined to a single row on each interstice; front tibiae with numerous long hairs on under surface.

Rostrum with median carina shining throughout. Antennae long and thin. Prothorax moderately transverse, sides strongly rounded, granules normally almost concealed. Elytra slightly wider than prothorax, base evenly incurved; without posthumeral swellings; with rows of large punctures, appearing much smaller through clothing; interstices almost even. Two basal segments of abdomen flattened and minutely granulate in middle. Front coxae widely separated, tibiae rather thin, front and hind ones moderately arched at apex, and longer than the middle pair. Length, 4-5 mm.

♀. Differs in having the elytra wider, two basal segments of abdomen evenly convex, legs shorter, and front tibiae without special clothing.

New South Wales: Darling River flood of May and June, 1890 (R. Helms). Types, in Australian Museum; cotypes, in South Australian Museum.

With the general appearance of beach-frequenting species of *Timareta*, but with fairly distinct ocular lobes, and apical incurvature of prosternum well defined. The intercoxal process of the mesosternum, in the female, is wider than the coxae, but the 1926 key deals only with males; on the male of this species the process is scarcely perceptibly, if at all, wider than the coxae. In that key, passing *M. rufimanus* (which has much shorter legs and antennae and different clothing), it should probably be associated with *M. pallidus* and *blackmorei*, which are very differently clothed, and with shorter antennae. The prothoracic granules are feebly traceable before abrasion, but after this they are seen to be moderately large and obtuse, certainly not very minute (as on the species of V) or ordinarily distinct (as on the species of VVV). On two specimens many of the scales have a silvery gloss. Several females were taken, but only one male.

Mandalotus modicus, n. sp.

♂. Black, antennae and tarsi obscurely reddish. Densely clothed with muddy-brown, feebly variegated scales, and with sloping and mostly pale setae, on the elytra confined to a single row on each interstice; tibiae with rather long hair on under surface, denser, but not very dense, on the front pair than on the others.

Rostrum with median carina fine and distinct to base. Antennae comparatively long and thin. Prothorax moderately transverse, sides strongly rounded, median line moderately impressed; granules traceable through clothing. Elytra at widest the width of prothorax, conjointly arcuate at base, posthumeral swellings feeble; with rows of large punctures, appearing much smaller through the clothing, alternate interstices feebly elevated. Metasternum and basal segment of abdomen concave in middle. Front coxae widely separated, almost as widely as the middle pair, front tibiae moderately arched at apex. Length, 4·5-5·5 mm.

♀. Differs in having the elytra across middle considerably wider than prothorax, basal segments of abdomen evenly convex, legs shorter, front tibiae less curved at apex, and without special clothing.

Queensland: Maryborough, abundant in flood debris, in January (E. W. Fischer).

The middle coxae are slightly more distant than the front ones, but referring the species to NN, in the key, it could be associated with *M. raui,* which is a smaller species, with much more separated front coxae; it somewhat resembles *M. piliventris,* but the abdomen is without the long clothing, which is so conspicuous on the male of that species. Referring it to NNN, the prothoracic granules associate it with VVV, of which *M. subglaber* is a smaller and more sparsely clothed species; *M. angustus* is narrower, with front coxae much closer together and paler clothing; and *M. ciliatus* has much more conspicuous clothing on front and hind tibiae. It differs from *M. albonotatus* in the clothing at base of elytra and middle of abdomen; *M. angustipictus* is narrower, with thicker scape; and *M. similis* has smaller prothoracic granules and shorter tibiae; and all three species, which it somewhat resembles, have front coxae less widely separated. It is slightly more robust than *M. villosipes,* the depression on the under surface shallower, and less trough-like in character, and front coxae twice as widely separated. On many specimens the clothing is obscured by dried mud, but even on others in perfect condition it is only feebly variegated. On abrasion the elytral punctures are seen to be distinctly wider than the striae, before abrasion they appear to be much less, they are larger on the male than on the female. The tibiae of the male are shining and with small granules internally, the hind ones from one point of view appear to be feebly dentate at the middle, and gently incurved between there and the apex. On one female the deciduous mandibular processes are present and boomerang-shaped.

Mandalotus oculivorus, n. sp.

♂. Dark brown, antennae and legs reddish. Densely clothed with greyish scales and with sloping setae.

Rostrum without visible median carina. Antennae moderately long. Prothorax slightly transverse, sides evenly rounded. Elytra across middle distinctly wider than prothorax, base conjointly slightly arcuate, without posthumeral swellings; punctures appearing small through clothing, or quite concealed; interstices even. Two basal segments of abdomen very slightly depressed in middle. Front coxae distinctly but not widely separated, middle coxae obtusely dentate. Length, 2 mm.

South Australia: Smoky Bay, in July (H. C. Allen).

A minute species, of which two specimens were sent by Mr. Allen as eating the eyes of seed wheat in the ground, and doing considerable damage. The front coxae are not very widely, although distinctly, separated, and in the key the species might be associated with NN, from all the species placed there it differs in being much smaller. If referred to NNN, it could be associated with *M. microscopicus,* from which, as also from *M. inconspicuus,* it differs in having the scape longer and thinner, sides of prothorax more rounded, and elytra wider in proportion. *M. puncticollis* is an even smaller species, and has the front coxae touching. The middle coxae from some directions appear ridged, from another obtusely dentate, and the species is much smaller than any other having dentate or subdentate coxae. The clothing is almost uniformly grey, except that the elytra have a darkly-lined appearance, due to the flattening down of the setae on each interstice, but in some lights the elytral scales have a slight golden lustre. On a female sent with the type, the setae are more conspicuous and on the elytra are not flattened down. A female, from Adelaide, that appears to belong to the species, has the golden gloss distinct on the prothorax and elytra, and numerous small granules are distinctly traceable, on the type no granules are. Another female, from the Mount Lofty Ranges, has the elytra and most of the under surface black. It is probable, however, that the colour is variable, apart from the age of the specimens. On all four specimens the median carina of the rostrum, if present, is entirely concealed.

The females have the abdomen evenly convex, middle coxae simple, tibiae shorter, with shorter clothing (on the tibiae of the male the under surface is clothed with long hair, but it is rather sparse, even on the front pair).

Mandalotus acanthocnemis Lea.

Fig. 9.

Mr. Oke gave a figure of a front leg as of this species (p. 183, fig. E), showing the femur as dentate, and the tibia as having a fairly large triangular tooth. No doubt from certain directions the femur may appear dentate, but it is not so on the type; the tibial tooth is also more acute than as figured by him, but it is evidently variable (see his note at p. 181).

Mandalotus egenus Oke.

There are two specimens of this species, from Trafalgar, Victoria, in Mr. F. E. Wilson's collection. They agree well with the description, and I concur in Mr. Oke's opinion that a new section "DD, *eee*. A transverse carina on second segment—*egenus*" would be required to fit it into the 1926 key.

Mandalotus excavatus Lea.

A specimen probably belonging to this species, is in the Macleay Museum, from the Clarence River. It is immature, as the general colour is castaneous, and the right mandibular process is still present. It is considerably larger (6 mm.) than the type, and the elevation on each side of the basal segment of abdomen is stronger, and produced upwards, so that it should be regarded as a tubercle; as such, in the key, instead of being placed with DD, it could be placed with D, and associated with *M. taylori,* which has very different prothoracic sculpture, and front coxae separated only half the distance.

Mandalotus ferrugineus Lea, var.

Two specimens, sexes, from Laureldale, New South Wales, apparently represent a variety of this species. They differ from the types in being larger (male 10 mm., female 8 mm.). The male has the abdomen partly abraded, exposing a curved ridge, hardly a carina, on the basal segment, arched forwards,

and a series of small granules on each of the third and fourth; the middle coxae are ridged but not as acutely as on the type (on the type from some directions they appear to be dentate); on partial abrasion its prothorax is seen to be transversely sculptured; the elytral tubercles and projections at the base are exactly as on the type. At first glance they appear to belong to *M. mirabilis,* but the male is without the long clothing of the under surface of that species, and differs in other respects.

MANDALOTUS DECIPIENS Lea.

Fig. 21.

A sketch is given showing the greatest curvature of the hind tibiae, for comparison with the sudden notch near the apex of that of the following species.

MANDALOTUS GLABER Blackb.

Figs. 15, 22, 23.

A sketch is given of the remarkable middle tibiae of this species, and two others of the hind ones from different points of view.

MANDALOTUS INTEROCULARIS Lea.

Numerous specimens from Cressy (Victoria) belong to this species, but are unusually large, 6·5-7·5 mm., excluding the rostrum; the carina on the basal segment of the abdomen of the male is of the same shape and position, but there is a narrow groove immediately anterior to it, so that it appears double (on typical specimens this is scarcely indicated), the legs are somewhat stouter, and the front coxae are slightly more widely separated.

MANDALOTUS IRRASUS Lea.

The female of this species differs from the male in being more robust, two basal segments of abdomen moderately convex, and legs somewhat shorter.

MANDALOTUS MEDCOXALIS Lea.

Additional males of this species, from Dorrigo, range in length 4-7 mm. The female differs from the male in having the two basal segments of abdomen feebly convex, the legs shorter, middle coxae unarmed, and hind tibiae less strongly curved.

MANDALOTUS METASTERNALIS Lea.

A male of this species, the second I have seen, from Teralba, New South Wales, in Mr. H. J. Carter's collection, is smaller (3·5 mm.) than the type, and has the tubercles of the metasternum smaller, although fairly distinct when viewed from the sides, the front tibiae are also less curved at the apex, and the granules of the hind tibiae are very indistinct.

MANDALOTUS NIGER Lea.

Figs. 25, 26.

I have previously[1] commented upon a specimen of this species as having the mesosternal process rounded, instead of slightly produced, and there is now another male, from Illawarra, before me in which it is transversely elliptic.

MANDALOTUS NODICOLLIS Lea.

A specimen of this species, in the Australian Museum, taken between Bourke and Wilcannia, on the Darling River, has the scales of the upper surface whitish-grey, and the setae unusually long. Most of the specimens previously seen were so densely covered with dried mud that the scales were entirely concealed.

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(1) Lea, Trans. Roy. Soc., S. Aust., 1911, p. 75.

Mandalotus pentagonalis Lea.

Figs. 10, 11.

Mr. Goudie has recently taken specimens of this species, at Black Rock, Victoria, by sieving fallen leaves. The type was immature, the fresh specimens are darker, and on several of them the scales on the upper surface are almost entirely black. The front tibiae of the male have a slight notch near the outer apex, but it is invisible from most directions. The female differs from the male in being more robust, mesosternum with intercoxal process transverse and unarmed, abdomen more convex, and legs shorter, with the front tibiae not notched.

Mandalotus rufipes Lea.

M. graminicola Oke.

The type of *M. rufipes* is a female, and was omitted from the 1926 key for that reason. Mr. Oke has recently sent us three paratype males of *M. graminicola,* which undoubtedly belong to the same species; he considered it could be associated with *M. bryophagus,* in the key, and in fact at first glance the front coxae appear to be in contact, but, examining them closely, there is seen to be a fine line between them (this is more pronounced on the female owing to her smaller coxae), so that, in the key, its real place is with *M. blackburni,* a much larger species without tubercles on elytra. Mr. Oke's specimens are slightly darker than the type, and the sides of the prothorax are less dilated; on two of them the median carina of the rostrum is scarcely traceable, on the other, owing to partial abrasion, it is distinct. The male is distinct from all the species with abdomen carinated, by its small size, and conspicuous elytral tubercles.

Mandalotus tenuis Lea.

At the foot of his description of *M. egenus,* Mr. Oke said he considered that this species should be placed in a separate genus, with *M. tenuis,* "as neither can be said to have ocular lobes." In my description of *tenuis* I noted: "The ocular lobes and the incurvature of the prosternum are unusually feeble." They are certainly very feeble, on both species, but in *Timareta* they are non-existent.

Mandalotus tibialis Lea.

Figs. 12, 13.

Some specimens of this species were sent from Moss Vale, New South Wales, as destructive to cabbages. The largest male measures 5 mm. in length. The female differs from the male in having the middle coxae unarmed, the front tibiae without the remarkable projection near the base, and the hind ones not multicarinate internally.

Timareta infortunata, n. nom.

Mandalotus pusillus Lea.

Mr. Oke has called my attention to the fact that in transferring *M. pusillus* to *Timareta,* I overlooked that Blackburn had previously[2] described a *T. pusilla.* I, therefore, propose the above name as a substitute.

Cryptoplus Er., Wiegm. Arch., 1842, I., p. 198.

Aolles Pasc., Journ. Linn. Soc., Zool., X., 1870, p. 450.

Cryptoplus was referred by Erichson to the Erirhinides, and as nearest to *Anoplus.* It was evidently unknown (except by description) to Lacordaire, who relying on Erichson's description and comments also placed it next to *Anoplus,*

(2) Blackburn, Proc. Linn. Soc., N.S.W., 1893, p. 265.

and treated it as the typical form of the Cryptoplides, which he placed as the third "Groupe" of the Erirhinides. It was unknown to Pascoe, Blackburn and others, all of whom allowed it to remain in the Erirhinides.

Although when dealing with clawless, and apparently clawless, Curculionidae of Australia I considered the genus, not actually knowing it, and having searched for it many times, especially amongst the Tasmanian weevils before me, without success, no reference was made to it.

Early in 1931 I appealed to Dr. Walther Horn for information as to the antennae and tarsi of the type; he informed me that it was in the Zoological Museum of the Berlin University, where Mr. Korschefsky examined it and stated "that the funicle has only six joints and the tarsi only one claw." Subsequently Prof. Dr. Kuntsen, of the institution, courteously sent it to me for examination.

On arrival in Adelaide it was at once apparent that it belonged to the genus *Aolles*. This genus I at one time considered as a subgenus only of *Haplonyx* (an opinion evidently shared by Chevrolat), but subsequently, on account of the great number of its species, treated as of generic rank. It is, in fact, doubtful if *Cryptoplus* should be regarded as more than a subgenus of *Haplonyx*, and it is certain that it belongs to the Haplonycides, and not to the Erirhinides.

EXPLANATION OF FIGURES.

27, side view of head and rostrum of *Cryptoplus perdix* Er.; 28, of *C. orbiculatus* Lea; 29, of *C. rostralis* Lea.

CRYPTOPLUS PERDIX Er.

Aolles maculipennis Lea, var.?

Fig. 27.

Two of the characters mentioned by Erichson are misleading. He described the funicle as seven-jointed and the rostrum as straight.

The type is pinned and unset, and it is difficult from most directions to see the funicle sufficiently clearly to count the joints, but from one direction and in a good light, it was quite distinctly seen to be six-jointed only (as it is on all the species previously referred to *Aolles*, and this character, with the apparently triarticulate tarsi, were relied upon by Pascoe as entitling that genus to separation from *Haplonyx*). Its rostrum is also not quite straight, although twice noted as "rectum," the curvature is certainly very slight, but is sufficiently distinct from the sides; on most species of the genus, however, it is quite straight, although on a few it is slightly more curved and thinner than on that species. It is also somewhat longer and thinner on the female than on the male of all the species, of which both sexes are before me, and there is sometimes a faintly increased curvature on the female. From above it appears considerably wider than from the sides. I have carefully compared the type with all of the 33 species referred to *Aolles* (except *nuceus*, not represented in the Adelaide collections, but which may belong to *rubiginosus*), and, although quite an ordinary looking species, it does not agree perfectly with any of them.

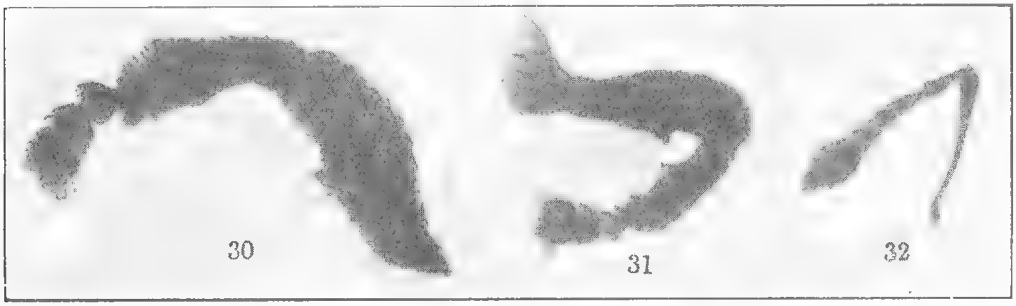
The markings of the upper surface are nearest to those of *C. variegatus*, whose rostrum is black and quite straight, and practically identical with those of a male of *C. maculipennis*, whose rostrum is quite straight on the under surface and feebly curved at the apex on the upper surface (most specimens of *maculipennis*, however, do not resemble it very closely). *C. nigrirostris (Haplonyx)* is also very close, but on all the many specimens of that species before me (some

smaller and some larger than the type of *perdix)*, there is a postmedian fascia on the elytra, and the rostrum is quite straight and black. *C. ornatipennis* (of which I have taken a specimen at Hobart) is very close to, if not a variety of, *nigrirostris*. *C. intermedius* has a more distinctly curved rostrum (but which is black), and is a decidedly narrower species. *C. pictus* has a feebly curved black rostrum, but has striking markings on elytra. *C. rostralis* is a larger, fasciate species, with a longer and more curved rostrum. All the other species are very distinct from it.

Cryptoplus orbiculatus Lea *(Aolles)*.

Figs. 28, 30-32.

Three photomicrographs are given to show the antennae and legs of this common species, also an outline figure of the side of the head and rostrum.



Explanation of Figures.

30, front leg of *Cryptoplus orbiculatus* Lea; 31, middle leg; 32, antenna.

Cryptoplus rostralis Lea *(Aolles)*.

Fig. 29.

On this species the rostrum is longer and more curved than on any other species before me.

Menios.

As previously noted[3] the character of the "Metasternum longer than the first abdominal segment" of the original species, is not to be depended upon, and on each of the four species here described, it is slightly shorter than that segment.

Menios spurcus, n. sp.

♂. Black, some parts blackish-brown, antennae and tarsi paler. Densely clothed with soft, muddy-brown scales, in places with obscure markings, and interspersed with numerous stout, erect setae, some of which form fascicles.

Rostrum about the length of prothorax, basal two-thirds densely clothed, elsewhere subopaque and with small punctures. Antennae inserted about two-fifths from apex of rostrum. Prothorax distinctly transverse, sides strongly rounded, apex less than half the width of base; with dense, concealed punctures. Elytra oblong to near apex, distinctly wider than prothorax; with rows of large, partly concealed punctures. Femora rather strongly and acutely dentate; tibiae thin. Length, 4·8-5·2 mm.

♀. Differs in having rostrum slightly longer, clothed only on basal third, elsewhere shining and with small punctures, and basal segment evenly convex, instead of flattened in middle.

North Australia: Darwin (G. F. Hill).

(3) Lea, Trans. Roy. Soc., S. Aust., 1913, p. 285.

A dingy species, somewhat like *M. nebulosus*, but with facets of eyes slightly smaller, elytral fascicles differently disposed, the setae more numerous, and lateral interstice not glabrous. *M. sordidatus* has clothing of much the same colour, but more evenly plating the surface, and with different fascicles. On each of two specimens there is a fairly distinct dark fascia, across the middle of the elytra, but narrowed at the suture, and some still more obscure subapical spots; from two others markings are practically absent. There are some scattered setae on the prothorax, but four distinct fascicles across middle, four less distinct ones at base (these appear to be easily abraded), and two feeble ones at apex; on the elytra scattered setae are rather numerous, and there are three or four feeble fascicles on the third interstice, and a few still more feeble ones elsewhere.

Menios ferrugineus, n. sp.

♀. Blackish, antennae and tarsi reddish. Densely clothed with rusty-brown scales, in places mottled with sooty-brown; with stout setae scattered about, and forming numerous fascicles.

Rostrum not very stout, apical two-thirds shining and with small punctures. Antennae inserted about two-fifths from apex of rostrum. Prothorax moderately transverse, apex suddenly narrowed and less than half the width of base; with dense, concealed punctures, and a short median carina. Elytra much wider than prothorax, parallel-sided to beyond the middle; with rows of large, setiferous, partly concealed punctures. Basal segments of abdomen evenly convex. Femora strongly and acutely dentate, tibiae thin and compressed. Length, 5·5 mm.

Queensland: Kuranda (F. P. Dodd). Unique.

At first glance apparently belonging to *Tychreus*, but with the coarsely faceted eyes of *Menios*. There are six fascicles on the prothorax, of which the two median ones are more distinct and supported on larger tubercles than the others; on the elytra there are three fairly large fascicles on the third interstice, three smaller ones on the fifth, and a few still smaller ones elsewhere. The dark mottlings of the elytra are almost confined to the apical slope and middle of sides, and on the prothorax to the sides, they also form obscure rings on the legs.

Menios poecilopterus, n. sp.

Blackish, antennae and tarsi reddish. Densely clothed with rusty-brown scales, mottled with paler and darker ones, and with numerous short setae, in places compacted to form feeble fascicles or clusters.

Rostrum about the length of prothorax, not very thin, basal half clothed; elsewhere subopaque and with dense and small punctures. Antennae inserted slightly nearer apex than base of rostrum. Prothorax moderately transverse, sides strongly rounded, apex about half the width of base; with dense, concealed punctures. Elytra parallel-sided to near apex; with rows of setiferous punctures indicated through clothing, alternate interstices slightly elevated. Basal segment of abdomen slightly flattened in middle. Femora strongly and acutely dentate, tibiae rather thin. Length, 5 mm.

Queensland: Cairns (J. A. Anderson). Type (unique), in Queensland Museum.

Near *M. albifasciatus* and *spurcus*, and like those species its fascicles are few in number and ill-defined. In many respects they approach *Evaniocis*, but the species of that genus have the club essentially different. It has the general appearance of *Phlaeoglymma mixta*, but differs from the genus in having the mesosternal receptacle more elevated and cavernous, and eyes with coarser facets. The pale scales on the upper surface are usually in small spots, of which several form a curved line on each shoulder, and an irregular fascia crowning the apical slope; the dark spots are still smaller in area, and many are due to clusters of

blackish setae; of the setae there are many on the prothorax, compacted to form six clusters, scarcely fascicles; on the elytra the black setae form fairly long spots on the third interstice, near the base, and at the middle, on the second before the middle, and some irregular clusters before and behind the pale humeral spots; on the pale spots some of the setae are almost white. There is a single line of scales on the inner side piece of the mesosternum. The type is probably a male.

Menios papuensis, n. sp.

♂. Blackish, some parts obscurely paler. Densely clothed with rusty-brown scales, variegated with paler and darker ones, and with numerous setae, in places forming fascicles.

Rostrum moderately stout, distinctly curved, the length of prothorax; with dense and rather small, but sharply-defined punctures, concealed only about basal third. Antennae inserted slightly nearer apex than base of rostrum. Prothorax moderately transverse, sides strongly rounded, apex less than half the width of base; with large, setiferous punctures, and smaller concealed ones. Elytra much wider than prothorax, parallel-sided to near apex; with rows of rather large, rough, partly concealed punctures; many of the interstices with small granules, more numerous on the ninth than on the others. Basal segment of abdomen flattened in middle. Femora stout, strongly and acutely dentate, tibiae somewhat compressed. Length, 7 mm.

Papua: Mount Lamington (C. T. McNamara). Unique.

In the table of allies of *Chaetectetorus*[4] this species could only be referred to *Acrotychreus* or to a new genus; but, on the only known species of that genus, the femora are more clavate, more strongly dentate, and the tibiae are strongly arched at the base; the general appearance also is very different. The upper surface is strikingly like that of *Pseudometyrus antares*, but the rostrum is wider, moderately curved, and the facets of the eyes are larger. The species of *Metyrus* have the rostrum stouter, facets of the eyes smaller, and tibiae wider. The metasternum is slightly shorter than the following segment, and as this is the only character which separates it from the original species of *Menios*, and the difference between the two sclerites being variable, it appears desirable to refer it to that genus, now first recorded from New Guinea. On the upper surface the scales are irregularly mixed, no fairly large patch being of any one shade of colour, although the fascicles are mostly composed of dark setae; on the prothorax there are two rather feeble clusters of setae in front, and four distinct fascicles across the middle; on the elytra there are two fairly large fascicles, supported on tubercles, on the third interstice (one near the base, the other postmedian) and a smaller one behind, four small ones on each side of the suture (the largest crowning the apical slope), three small ones on the fifth, and very feeble ones on the seventh. On the sides of the prothorax, invisible from above, the lower margins of the punctures appear as small, shining granules.

Menios nebulosus Lea.

Two specimens from South Australia (Mount Lofty and Kangaroo Island) appear to belong to this species, but differ from the types in being slightly larger and with more white scales on the elytra; these form oblique vittae from the shoulders to near the suture at the basal third, and a moderately distinct fascia at the summit of the apical slope; on the Island specimen the sides of the prothorax and base of elytra are clothed with fawn-coloured scales. In general they are strikingly close to *Phlaeoglymma mixta*, but have the mesosternal receptacle cavernous, instead of open.

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(4) Lea, Proc. Linn. Soc. N.S.W., 1909, p. 594.

MENIOS ALTERNATUS Lea.

A male from Dunk Island, in the Queensland Museum, is paler than usual, and has a fairly well-defined white V on the elytra, touching the suture at the basal third, and almost touching the shoulders; there is a fairly large irregular dark spot on each elytron. The fascicles of its upper surface are ill-defined, being represented only by a few feebly compacted scales.

MENIOS INTERNATUS Pasc.

Mr. F. E. Wilson has reared specimens of this species from stalks of the waratah *(Telopea speciosissima)*, at Mount Victoria (New South Wales).

Metyrculus sordidus, n. sp.

♂. Black, antennae and tarsi reddish. Densely clothed with sooty-brown and paler scales, and with numerous short, stout, sloping setae.

Rostrum stout, slightly shorter than prothorax, dilated to apex, densely clothed throughout. Antennae inserted slightly nearer base than apex of rostrum. Prothorax very little wider than long, sides rather strongly rounded; punctures concealed. Elytra much wider than prothorax, parallel-sided to near apex; with rows of large punctures, appearing small through clothing. Mesosternal receptacle briefly Y-shaped. Metasternum and basal segment of abdomen subequal, the latter faintly depressed in middle. Femora not very stout, edentate. Length, 3·5 mm.

Queensland: Bowen (Aug. Simson). Unique.

The mesosternal receptacle, somewhat elevated and keeled, associates this species with *M. mediofasciatus*, which is a much larger and otherwise different species; it is about the size of *M. trimaculatus*, but the elytra are not bimaculate at the median third, and the scales on the metasternum are not individually distinct; on *M. cinerascens* the mesosternal receptacle is U-shaped. Most of the scales on the upper surface are sooty-brown, with some pale ones on the scutellum and near the shoulders, and some small, inconspicuous spots elsewhere; on the under surface, both of body and of legs, most of the scales are whitish. The setae nowhere form fascicles, or even clusters, and they are usually of the same colour as the scales amongst which they are placed; they form a regular row on each elytral interstice.

Metyrculus semicircularis, n. sp.

♂. Dark brown, antennae paler. Densely clothed with slaty-grey, sooty, and white scales, and with numerous short, sloping setae, in places compacted to form fascicles or clusters.

Rostrum wide, slightly shorter than prothorax, sides somewhat dilated to apex, densely clothed throughout. Antennae inserted almost in middle of rostrum. Prothorax very little wider than long, sides gently rounded, apex about half the width of base; punctures concealed. Elytra much wider than prothorax, parallel-sided to beyond middle; with series of large punctures, appearing much smaller through clothing, or quite concealed. Mesosternal receptacle briefly U-shaped, base not keeled. Femora edentate. Length, 2·0-2·5 mm.

Torres Straits: Cornwallis and Mabuiag Islands (C. T. McNamara).

Allied to but slightly smaller than *M. sinuatus*, and with more pale scales on the pronotum, the base of the mesosternal receptacle is also slightly smaller (much as that of *M. cinerascens)*. Most of the scales on the upper surface of the Cornwallis Island specimens are slaty-grey, with some small dark spots, sometimes sooty, on the sides of the elytra; on the prothorax there is a distinct white semicircle, its ends touching the elytra near the shoulders, and less distinct pale markings on the apical sides; on the elytra there are small white spots about the

shoulders, crowning the apical slope, and about the apex; there are some dark markings on the legs, but most of the scales on the under parts are white. The setae are mostly dark, and form feeble clusters on the prothorax, and two fairly distinct fascicles on the third interstice on each elytron. On the Mabuiag Island specimens the semicircle on the pronotum is present, but less distinct; on one of them the pale markings of the elytra are more conspicuous, and form a rather wide but not uniform fascia across the summit of the apical slope (to a certain extent this specimen resembles *Achopera bifasciata*, but that is a decidedly narrower species, with a larger mesosternal receptacle); on another they are less distinct; on each of them, in addition to the fascicles on the third interstice, there is a small one on the second, and another on the fifth. All the specimens taken appear to be males.

A specimen from Cairns, in the Macleay Museum, appears to belong to the species, but is slightly larger (2·8 mm.), the semicircle on the prothorax is feeble (but can be traced); white spots are absent from the elytra (or very feebly defined), most of their scales being pale slaty-grey, with some irregular dark spots on the sides. Where its scales have been abraded the derm is seen to be reddish, probably from immaturity.

Metyrculus postscutellaris, n. sp.

♀. Black, antennae and tarsi reddish. Densely clothed with pale rusty-brown scales, becoming mouse-coloured on most of apical half of elytra, mostly brown on abdomen, but with some blackish and whitish ones, whitish and brown on metasternum; elytra with a row of inconspicuous, short, sloping setae on each interstice, but with a distinct white one in each seriate puncture.

Rostrum rather wide, the length of prothorax, quite straight, basal third clothed, elsewhere shining and with small but distinct punctures. Antennae inserted slightly nearer apex than base of rostrum. Prothorax distinctly transverse, sides strongly narrowed near apex, which is less than half the width of base, with five fascicles, supported on slight tubercles, transversely placed slightly in advance of middle, the median one slightly larger and with paler scales than the others; with dense, concealed punctures. Elytra closely applied to and no wider than prothorax, parallel-sided to beyond the middle; with rows of fairly large punctures, and with a few small (and usually concealed) granules; with a small granulate swelling immediately behind the scutellum. Mesosternal receptacle with emargination short and wide. Metasternum slightly shorter than first segment of abdomen, but longer than second. Femora stout, edentate, and strongly grooved, tibiae compressed. Length, 6·5 mm.

♂. Differs in having rostrum slightly shorter and wider, opaque, and with crowded punctures, antennae inserted slightly nearer the apex of rostrum, and two basal segments of abdomen flat in middle, instead of convex.

Queensland: Cairns (Dr. W. Horn, from H. Hacker, and Lea collection, from Dr. E. W. Ferguson).

Somewhat larger and distinctly wider than any other species of the genus; to a certain extent its appearance is suggestive of *Tychreus*, but the femora are edentate and strongly grooved. There are no true fascicles on the elytra, but the post-scutellar elevation is very distinct. The head and rostrum of the male being badly abraded, and only part of one antenna left, the female was made the type of the species.

Metyrculus mediofasciatus Lea, var.

Two specimens from Ebor (New South Wales) agree in many respects so perfectly with the types of this species, that they can hardly represent more than a variety of it; but they have the median fascia of the elytra snowy-white (with a few darker scales and setae in it), on the abdomen and legs nearly all the scales

are also snowy-white, and on the abdomen they are nearly all distinctly longer than wide (subsetose in character, although adpressed). On the types of the species the abdominal scales are all brown and much shorter, most of them being quite circular. A specimen from Dorrigo has the elytral fascia white, with the abdominal scales equally thin, but of a darker colour than on the Ebor specimens.

METYRCULUS BIMACULATUS Lea, var. C., n. var.

A male from Eccleston (New South Wales) is larger (6 mm.) than usual, and the white spot on each elytron is broken up into two narrow strips on the fourth and sixth interstices, the part on the sixth being slightly nearer the base than the part on the fourth. A somewhat similar, but slightly larger specimen, was in the Blackburn collection, the spot on its right elytron is divided as on the Eccleston specimen, but not that on the left.

PSEUDOMETYRUS CYLINDRICUS Lea.

A female of this species, from Tasmania, differs from the male (the only sex hitherto known), in having the rostrum parallel-sided, shining, and with minute punctures from apex to behind antennae, and then rapidly increasing in width to base; the antennae are also inserted nearer the middle, and the abdomen is more convex.

PSEUDOMETYRUS BICAUDATUS Lea.

A specimen of this species from Dorrigo (New South Wales), differs from the type in having most of the elytral scales (except those forming fascicles) dark green, with a slight metallic gloss; a few of the prothoracic scales are also somewhat greenish, but most of them are deep black.

PSEUDOMETYRUS ANTARES Er.

A male in the Queensland Museum (labelled as taken in January, 1893, by C. J. Wild, on Mount Tambourine), appears to belong to this species, but differs from Tasmanian specimens in being somewhat larger (10 mm.).

Achopera alba, n. sp.

♀. Black. Densely clothed with whitish scales, interspersed with stout, depressed, whitish setae, except that on the prothorax some are brownish.

Rostrum about the length of prothorax, not very wide in front, but dilated from insertion of antennae (slightly nearer base than apex) to base; basal third densely clothed, elsewhere glabrous (except for a few setae on sides), highly polished and with a few small punctures. Prothorax moderately transverse, sides rather strongly rounded, apex more than half the width of base; punctures concealed. Elytra distinctly but not much wider than prothorax, base distinctly trisinuate, sides parallel to beyond the middle; with rows of large punctures appearing narrowly oblong through clothing. Mesosternal receptacle rather strongly elevated, base short. Metasternum slightly longer than basal segment of abdomen along middle, twice as long at sides. Femora not very stout, edentate. Length, 8 mm.

Western Australia: Eradu (J. Clark).

This and the following species have a strong general resemblance to *A. isabellina,* but the scales are consistently larger, and with a somewhat woolly appearance, they may, however, be at once distinguished by the elytral setae; on that species they are thin and true setae; on this they are much wider, and appear like larger scales, set in rows on the interstices; there are other differences in the rostrum and antennae; *isabellina,* so far, is only known from Queensland.

Achopera subalba, n. sp.

♂. Blackish, antennae and tarsi reddish. Densely clothed with whitish scales, with scattered brownish ones of various shades, but not forming distinct spots, and interspersed with stout, decumbent setae.

Rostrum the length of prothorax, rather wide, sides gently incurved to middle, where the width is slightly more than the distance separating eyes; basal third densely clothed, elsewhere moderately clothed, but punctures traceable. Scape inserted nearer base than apex of rostrum, and much shorter than funicle. Prothorax moderately transverse, sides strongly rounded; punctures concealed. Elytra oblong-cordate, distinctly wider than prothorax, base incurved only at scutellum; striae distinct, but punctures entirely concealed. Length, 5 mm.

North Western Australia: Wyndham, in January (J. Clark).

In general appearance like a small specimen of the preceding species, but with a fine longitudinal impression on the rostrum at its narrowest part. The two species may be distinguished as follows:—

A. subalba.	*A. alba.*
Elytra at base not incurved near each shoulder.	Elytra trisinuate at base, as a result the shoulders slightly clasp the base of prothorax.
Prothoracic scales large, and not mixed with setae.	Prothoracic scales slightly smaller and mixed with setae, which, although depressed, are distinct by their darker colour.
Scales of under surface large and almost uniform.	Scales of under surface smaller, denser, and mixed with stout, adpressed setae.

Achopera pictiventris, n. sp.

♂. Blackish, antennae and tarsi reddish. Densely clothed with sooty scales, with pale markings, and interspersed with depressed setae.

Rostrum moderately stout, slightly shorter than prothorax, sides gently incurved to middle; basal half densely clothed, apical half almost glabrous and with dense punctures. Scape inserted slightly nearer base than apex of rostrum, and much shorter than funicle. Prothorax moderately transverse, gently convex, sides strongly rounded, apex less than half the width of base; with dense, concealed punctures. Elytra at base not much wider than widest part of prothorax, not quite parallel-sided to near apex, base distinctly trisinuate; with rows of large punctures, appearing much smaller through clothing, or quite concealed, but striation evident. Mesosternal receptacle with base large, and emargination very short. Metasternum much shorter than basal segment of abdomen, and slightly shorter than second; basal segment with a wide, shallow depression, continued on to second. Femora edentate. Length, 4-5 mm.

♀. Differs in having rostrum thinner, less of the base clothed, elsewhere shining and with smaller punctures, two basal segments of abdomen evenly convex, and legs slightly shorter.

Western Australia: Perth (H. M. Giles).

A dingy species, with distinctive abdominal clothing, which might, with equal propriety, be referred to *Achopera* or *Metyrculus,* the character of the metasternum, longer or shorter than the following segment, formerly used in the table of allies of *Chaetectetorus,* is not to be relied upon. As in its flatter body, widely concave abdomen of male, abdominal clothing, and depressed setae of upper

surface, it agrees more with the species of *Achopera,* it is referred to that genus; from *A. lachrymosa* it differs in being wider and metasternum decidedly shorter. On *A. sabulosa* the metasternum is quite as short, but the clothing is very different. *A. maculata* is a narrower species, with very different abdominal clothing. In appearance it is fairly close to some varieties of *Meniomorpha inconstans,* but the rostrum is much shorter. From *Metyrculus bimaculatus* and *mediomaculatus,* which have pale median spots on the elytra, it is at once distinguished by the abdominal clothing. The scales on the upper surface are mostly sooty, with some feeble brownish spots on the sides of prothorax and apical half of elytra; there is, however, a small, conspicuous white spot, on the third and fourth interstices on each elytron, at the basal third; on the metasternum there is a sooty vitta on each side of the middle; on the abdomen of the male a wide median portion has sooty scales, the sides with whitish ones, on the legs the scales are whitish and sooty; on the female, the whitish median line of the metasternum is continud along the two basal segments of abdomen.

Achopera microps, n. sp.

♂. Dark brown, legs and antennae reddish. Densely clothed with chocolate-brown and stramineous, or whitish, scales, interspersed with sloping setae.

Rostrum not very thin, the length of prothorax; densely clothed except at muzzle, which is shining and with small punctures. Scape inserted in middle of rostrum, much shorter than funicle. Prothorax as long as wide, sides gently rounded, apex half the width of base; punctures concealed. Elytra not much wider than prothorax, almost parallel-sided to near apex, base gently trisinuate; with rows of large, subquadrate punctures, appearing much smaller through clothing, or quite concealed, but striation distinct. Mesosternal receptacle rather solid, emargination short. Metasternum distinctly longer than basal segment of abdomen, the latter gently depressed in middle. Femora edentate. Length, 3·5-4·0 mm.

♀. Differs in having the rostrum thinner, apical half shining and with small punctures, and basal segments of abdomen gently convex.

New South Wales: Dorrigo (W. Heron). Two specimens.

A narrow, depressed species, with general outlines much as those of *A. lachrymosa,* but with different scales and setae; it is narrower than *A. uniformis,* and the metasternum is longer. The prothoracic markings resemble those of some specimens of *A. alternata,* but the elytral interstices are even. The eyes are smaller, and the tarsi narrower than is usual in the genus. At first glance it looks somewhat like *Ephrycinus pilistriatus,* but is flatter, with much less conspicuous setae. On the male the scales on the prothorax are mostly pale, with a large, irregular, medio-basal brown patch; on the elytra the pale markings cover about one-fourth of the surface, in irregular spots and asymmetrical fasciae; on the female the brown patch on the prothorax is broken up into four spots, and the pale markings on the elytra cover less of the surface; on each of them the clothing of the under parts is almost uniformly pale. The setae are usually of the same colour as the scales, on the elytra they form a regular row on each interstice.

Achopera multimaculata, n. sp.

♂. Blackish, antennae and tarsi reddish. Densely clothed with sooty-brown and obscurely whitish scales, interspersed with short, sloping setae.

Rostrum rather wide, slightly shorter than prothorax; densely clothed, except at tip, which is shining and with small punctures. Scape inserted slightly nearer base than apex of rostrum, and much shorter than funicle. Prothorax not much wider than long, apex more than half the width of base; with dense, concealed punctures. Elytra distinctly wider than prothorax, parallel-sided to near apex,

base moderately trisinuate; with rows of large punctures, appearing narrow through clothing, or quite concealed. Mesosternal receptacle large, with a basal stem, emargination short. Metasternum slightly longer than basal segment of abdomen, the latter shallowly depressed in middle. Femora stout, edentate. Length, 4·5 mm.

Torres Straits: Murray Island (A. M. Lea). Unique.

A multimaculate species, structurally like *A. lachrymosa,* except that the elytral striae are more pronounced. *A. uniformis* is wider, the dark clothing occupies less of the surface, and the setae are more distinct. The elytra are wider in proportion than those of the preceding species, the metasternum is but little longer than the following segment, and the eyes are slightly larger. The scales on the prothorax are mostly dark, with several small pale spots, of which three are conjoined to form a short, mediobasal Y; on the elytra the pale spots are small, numerous, asymmetrical, and two or more are sometimes transversely conjoined; on the under surface the scales are pale, but some of the setae are dark. The setae of the upper surface are distinct only from the sides, they form a regular row on each interstice.

Achopera longiventris, n. sp.

♂. Blackish-brown, some parts obscurely paler, antennae reddish. Sparsely clothed with stramineous and brownish scales, and with short, sloping setae.

Rostrum moderately stout and curved, the length of prothorax; sparsely clothed even at base, and with comparatively large and dense punctures, except on a narrow, shining median line. Scape inserted slightly nearer base than apex of rostrum, and much shorter than funicle. Prothorax not much wider than long; with dense and comparatively large punctures. Elytra slightly wider than prothorax, parallel-sided to near apex, base truncate; with rows of large, quadrate or oblong punctures, usually wider than interstices; the latter each with a single row of setiferous punctures. Mesosternal receptacle rather large, with a short basal stem. Metasternum and two basal segments of abdomen with rather large punctures; the former much shorter than basal segment (which is depressed in middle), and scarcely as long as the second, second slightly longer than third and fourth combined, and much longer than fifth. Femora not very stout, edentate. Length, 5 mm.

Queensland: Prairie, in October (— Chisholm). Unique.

A narrow, flat species, with two basal segments of abdomen unusually long. The general outlines are somewhat as on large specimens of *A. lachrymosa,* but the clothing is much sparser, many of the elytral punctures are not at all concealed, and are even more distinct than on *A. xanthorrhoeae,* which is a smaller species, with conspicuous markings. Although its clothing is much sparser than on all other species of the genus, the type does not appear to be abraded; there are several small spots of pale scales on the elytra; the setae are distinct only from the sides, they form a regular row on each interstice; on the under surface each of the punctures contains a seta, which seldom arises above the general level.

Achopera subcylindrica, n. sp.

Dark brown, antennae and tarsi reddish. Densely clothed with chocolate-brown and pale stramineous scales, interspersed with short, sloping setae.

Rostrum wide, shorter than prothorax; tip glabrous and with dense punctures. Scape inserted nearer base than apex of rostrum, and much shorter than funicle. Prothorax slightly longer than wide, apex almost the width of base; with dense, concealed punctures. Elytra not much wider than prothorax, parallel-sided to

near apex; with rows of large punctures, partly concealed by clothing, but striation distinct. Mesosternal receptacle rather stout. Metasternum and basal segment of abdomen subequal. Femora stout, edentate. Length, 2·0-2·2 mm.

Queensland: Cedar Creek (Dr. E. Mjöberg), Kuranda, in November (G. E. Bryant). Type, in Stockholm Museum; cotypes in British and South Australian Museums.

A minute, thin, subcylindrical species; the six specimens taken appear to be all males. It is about the size of *A. parva*, and with scales of the same colours, but differently disposed, and with much shorter setae; on *parva* the setae are numerous, and on the elytra the length is decidedly more than the width of an interstice, on the present species the setae are less erect, and indistinct (except from the sides), with the length decidedly less than the width of an interstice; the mesosternal receptacle is also different, on this species its emargination is widely transverse, on *parva* it is distinctly longer than wide. On the upper surface the brown scales may appear as numerous small spots, occupying less than one-fourth of the surface, to half or even three-fourths of it; on the under surface the scales are almost uniformly pale.

Isax tricostirostris, n. sp.

♂.* Black, antennae and claw joints obscurely reddish. Densely clothed with dark brown scales, slightly variegated with paler brown ones.

Rostrum thin, feebly curved, the length of prothorax; basal half with crowded punctures, and three thin ridges, apical half shining. Scape inserted slightly nearer apex than base of rostrum, and not quite extending to eye. Prothorax about one-fourth wider than long, apex about half the width of base; with dense and rather small punctures (scarcely larger than on head), and with a fine median ridge, extending to apex but not to base. Elytra somewhat flattened, distinctly wider than prothorax, sides gently rounded to near apex; with rows of fairly large, subquadrate punctures; interstices with rather dense punctures and minute granules, third, fifth, and seventh slightly elevated. Mesosternal receptacle U-shaped, no longer than wide. Metasternum about the length of second segment of abdomen, and distinctly shorter than first, the latter widely concave in middle. Femora stout, feebly grooved and edentate. Length, 8 mm.

New South Wales: Illawarra. Type (unique), in Macleay Museum.

The mesosternal receptacle not twice as long as wide, metasternum shorter than the following segment, and femora edentate are at variance with other species of the genus; the rostrum, although not quite straight, is but little more curved than on *I. planipennis*, and in general appearance it is close to that species. For the present it may be considered an aberrant member of the genus. The type is slightly abraded.

Sympiezoscelus foveiventris, n. sp.

Blackish-brown or reddish-brown, scape paler. With some whitish scales at base of rostrum, and sparse setae on legs.

Head with rather small but sharply defined punctures. Rostrum stout, about two-thirds the length of prothorax, sides incurved to middle; with rather coarse punctures about base, minute elsewhere. Scape stout, inserted about two-fifths from base of rostrum, and much shorter than funicle. Prothorax slightly transverse, sides rounded, and almost evenly decreasing in width to apex; with small but sharply defined punctures, becoming larger on sides. Elytra with outlines continuous with those of prothorax, base strongly trisinuate; with rows of fairly large and somewhat rugose punctures, the marginal and submarginal rows united at about one-third from base; interstices impunctate. Metasternum

depressed in middle, and bifoveate at base. Basal segment of abdomen with two large, subbasal foveae, suture with second with a row of punctures, apical segment irregularly bifoveate. Femora very stout, edentate, tibiae rather short, each with an acute tooth at outer apex. Length, 4·5-6·0 mm.

Queensland: National Park, in December, and Mount Nebo, in April (H. Hacker); New South Wales; Rivertree, in August (E. Sutton). Type, in South Australian Museum; cotypes in Queensland Museum.

A flattened, elongate-elliptic species, readily distinguished from *S. spencei* and *norfolcensis* by the foveae of the under surface, and the much smaller punctures of the upper surface. At first glance the specimens look like abraded ones of *Xestocis,* but on that genus the femora are strongly dentate. There are six specimens under examination, but no well defined sexual differences between them, although on a small one an oedeagus is protruding. Some specimens have the head entirely glabrous.

XESTOCIS NIGER Lea.

Two specimens from Dorrigo (New South Wales), have the elytra of a rather dingy red, with a large black spot on each side of the middle; on the type such spots are present, but scarcely traceable, on account of the darkness of the adjacent parts. On some specimens of *X. castaneus,* from Norfolk Island, there are somewhat similar spots, but on that species the elytral punctures are considerably smaller at the base.

Gymnocis, n. gen.

Head small. Eyes rather small, with coarse facets. Rostrum moderately wide, gently curved. Scape stout, much shorter than funicle; first joint of the latter rather long, second much shorter, the others strongly transverse; club briefly ovate. Prothorax slightly transverse, apex much narrower than base. Scutellum small. Elytra with outlines continuous with those of prothorax, non-striate. Mesosternal receptacle large, with a long central ridge, emargination very short; cavernous. Metasternum much longer than the following segment, largely excavated in middle, sides almost vertical; episterna rather narrow. Two basal segments of abdomen large and soldered together, third and fourth combined distinctly shorter than fifth, with deep sutures. Femora very stout, feebly grooved, edentate; tibiae compressed, with a small subapical tooth, in addition to terminal hook, the middle and hind ones each with a feeble projection near outer apex; tarsi thin. Elongate-elliptic, depressed, glabrous.

A remarkable genus, allied to *Bepharus* and *Sympiezoscelus,* but distinguished by the cavernous metasternum, and complete absence of elytral striae. The outlines are much as those of *S. foveiventris,* and the femora are similarly powerful. The cavity of the metasternum is continued as a wide, shallow depression, on the two basal segments of abdomen, and the latter are soldered together, even at the sides, their suture only marked by a curved row of minute punctures.

Gymnocis impunctatus, n. sp.

Blackish-brown, antennae and tarsi somewhat paler. Elytra with muddy-grey scales, and a few setae, only about apex, on front of head, base of rostrum, sides and tip of abdomen, and parts of legs; metasternum with a few setae between coxae, and a few on claw-joints.

Head polished and impunctate, except in front, where the punctures are concealed. Rostrum shining and impunctate, except at base. Scape inserted slightly nearer base than apex of rostrum. Prothorax with sides rounded, base narrowly margined; impunctate. Elytra with sides feebly dilated to basal third, and then narrowed to apex; without punctures, except a few concealed ones about apex. Length, 4·5 mm.

Queensland: National Park, under bark of a rotten hoop-pine *Araucaria Cunninghamii* in December (H. Hacker). Type (unique), in Queensland Museum.

At first glance apparently entirely glabrous and without punctures; the few that are present being more or less concealed by muddy-looking scales.

Idiopterocis, n. gen.

Head small, almost concealed from above. Eyes small, widely separated, with coarse facets. Rostrum moderately long, rather wide, moderately curved. Scape moderately stout, much shorter than funicle; first joint of funicle long, second shorter, the others small and transverse; club briefly ovate. Prothorax rather long, flat, sides almost vertical. Elytra nonstriate, with vertical sides. Mesosternal receptacle rather large, emargination widely transverse; cavernous. Metasternum distinctly shorter than the following segment; episterna narrow. Femora moderately long, feebly grooved, edentate; tibiae slightly compressed; tarsi thin. Elongate, flattened; irregularly squamose and setose.

A remarkable genus, evidently allied to *Bepharus, Sympiezoscelus,* and *Gymnocis,* but distinct by the elytra, metasternum and abdomen. In the table of allies of *Chaetectetorus,* it could be associated with *Metyrculus,* but the two genera differ in many particulars (prothorax, elytra, eyes, etc.). The elytral epipleurae, to a certain extent, are suggestive of those of *Zenoporopterus mirus.* The tarsi are thin, and the third joint, although bilobed, is not widely so. There is a minute process at the position of the scutellum, but I am not sure whether it is a real one, or a minute scaly depression; it is certainly not a distinct scutellum.

Idiopterocis trilinealbus, n. sp.

♂. Black, some parts shining, antennae and tarsi reddish. Irregularly clothed with white, or stramineous, scales and setae.

Head with dense, concealed punctures. Rostrum about the length of prothorax, with a fine median carina, and dense concealed punctures, except that the tip is glabrous, and with small punctures. Antennae inserted almost in middle of rostrum. Prothorax slightly longer than wide, sides feebly dilated from base to one-third from apex, and then narrowed to apex, which is more than half the width of base, base truncate; disc with fairly large, even punctures, becoming smaller on sides. Elytra closely applied to prothorax, with shoulders feebly clasping its base, sides slightly dilated to basal third, and then regularly narrowed to apex; parts polished and with sparse and minute punctures, except where clothed, both on disc and epipleurae. Two basal segments of abdomen widely and shallowly depressed, the first distinctly longer than second, second slightly longer than third and fourth combined, with straight sutures. Length, 3·3-3·5 mm.

♀. Differs in having rostrum slightly thinner, median carina shorter, about one-fourth of its apex glabrous, abdomen flat, and femora slightly thinner.

Lord Howe Island (A. M. Lea and wife). A pair taken, *in cop.,* on the under surface of a rotting log.

The prothorax is rather densely clothed with scales, each of which fills a puncture, but there are also a few setae arising above the general surface, on the sides the scales are smaller, and cover less of the surface; on the elytra there are three conspicuous lines of white scales (with a few long and slightly rusty setae), on the suture and crowning the vertical sides, with a few scattered scales, so the disc has two widely glabrous spaces, narrowing to apex, with the epipleurae also almost completely glabrous; the abdomen is glabrous, except on the sides; the femora and tibiae have pale scales and long setae. Most of the derm of the female is reddish, but probably from immaturity.

Mitrastethus lateralis, n. sp.

♂. Castaneous-brown. Densely clothed with light, muddy-brown, adpressed scales, slightly mottled with darker brown, but highly polished on outer side piece of mesosternum, on prosternum adjacent to it, on middle of metasternum, of two basal segments of abdomen, and hind coxae; each odd interstice of elytra with a row of short, sloping setae.

Rostrum feebly curved, the length of prothorax; apical fourth polished and almost impunctate. Scape stout, inserted slightly nearer base than apex of rostrum, and much shorter than funicle. Prothorax moderately transverse, apex less than half the width of base, which is strongly bisinuate and with a small median depression; with dense, concealed punctures. Elytra not much wider than prothorax, nowhere quite parallel-sided; with rows of rather large punctures, appearing much smaller through clothing; interstices with dense, concealed punctures. Femora stout, edentate, hind tibiae thicker than the others. Length, 5-6 mm.

♀. Differs in having rostrum longer, thinner, clothed only on basal third, and basal segments of abdomen gently convex in middle, instead of flattened.

Norfolk Island (A. M. Lea). Abundant.

A rather flat, elliptic species, with general appearance much as of the two previously named species, but each outer side piece of mesosternum, etc., highly polished and glabrous, in all the numerous specimens obtained. On some males of *M. australiae* the outer side piece is polished, although it usually has a few scales; but on the female it is usually as densely clothed as the adjacent parts; some Dorrigo specimens are quite as small as those of the present species, but the majority are considerably larger.

Mitrastethus australiae Lea.

Four specimens from Queensland, in the National Museum, have fairly numerous black setae scattered amongst the pale ones on the elytra. Numerous others from Dorrigo (New South Wales), are smaller than usual, and also have a few black setae scattered about, but less numerous than on the four others.

ATMOSPHERIC SATURATION DEFICIT IN AUSTRALIA

BY JAMES ARTHUR PRESCOTT, M.SC., WAITE AGRICULTURAL RESEARCH INSTITUTE

Summary

The importance of the saturation deficit of the atmosphere in water vapour pressure has received attention of recent years, particularly from workers in plant physiology and in soil science. The effectiveness of rainfall for plant life or in the process of soil leaching is governed by the evaporating power of the air, and it has been shown by Patton (1) and by the author (2) that for Australian rainfall and temperature.

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By James Arthur Prescott, M.Sc., Waite Agricultural Research Institute.

[Read August 13, 1931.]

The importance of the saturation deficit of the atmosphere in water vapour pressure has received attention of recent years, particularly from workers in plant physiology and in soil science. The effectiveness of rainfall for plant life or in the process of soil leaching is governed by the evaporating power of the air, and it has been shown by Patton (1) and by the author (2) that for Australian

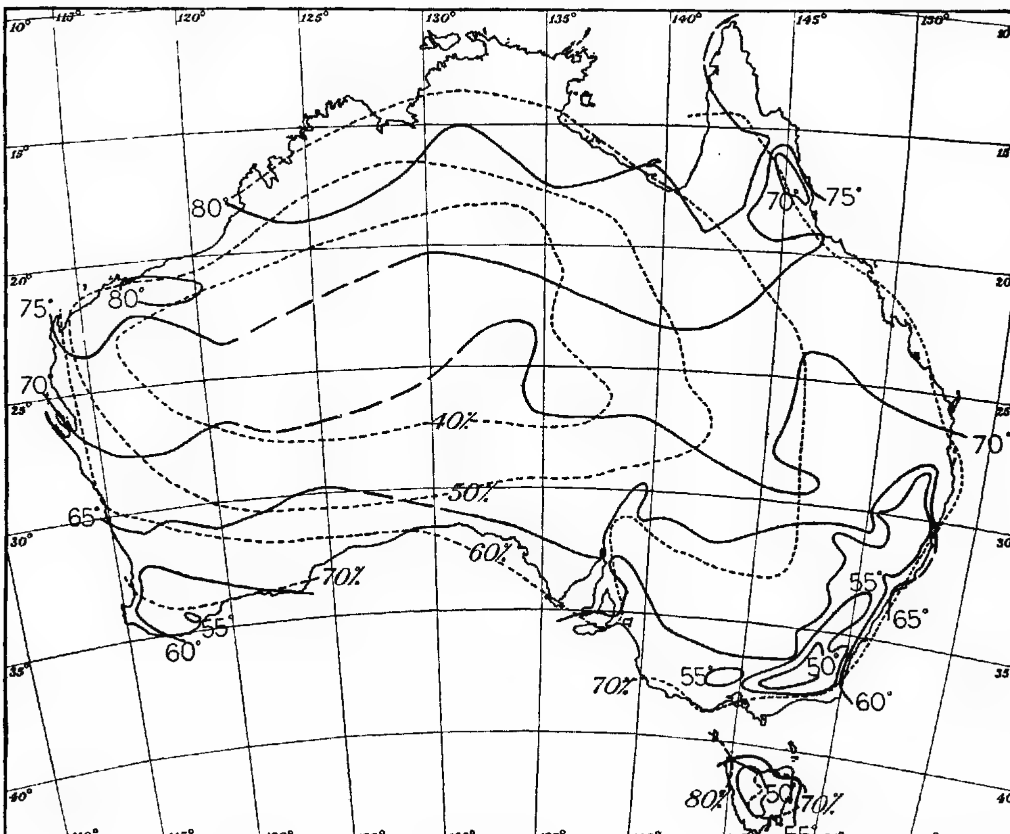

Fig. 1.

Map of Australia, showing mean annual temperatures and mean annual humidity based partly on data supplied by H. A. Hunt, 1929. Isotherms are indicated by continuous lines, humidity percentages by broken lines.

records the evaporation from a free water surface is probably a linear function of the saturation deficit of the air.

For twenty-three stations in Australia the mean evaporation in inches is related to the saturation deficit in inches of mercury by the following expression:—

$$E = 263 \text{ s.d.}$$

Of the factors which have been discussed in this connection, the most important are:—The Transeau ratio (3) of precipitation to evaporation, and the Meyer ratio (4) of precipitation to saturation deficit. Factors taking account of

rainfall and temperature include those of Lang (5), de Martonne (6), Emberger (7), and Crowther (8). It is very probable that in these latter cases for working over a wide range of temperature and humidity conditions, the saturation deficit will eventually prove to be more useful than temperature.

During the course of recent investigations on the distribution of soil types and vegetation associations in Australia, the probable values for the saturation deficit have been worked out from the most recent available temperature and humidity records, and these are submitted in the following maps. Fig. 1 indicates the data from which the saturation deficit isobars in fig. 2 have been calculated.

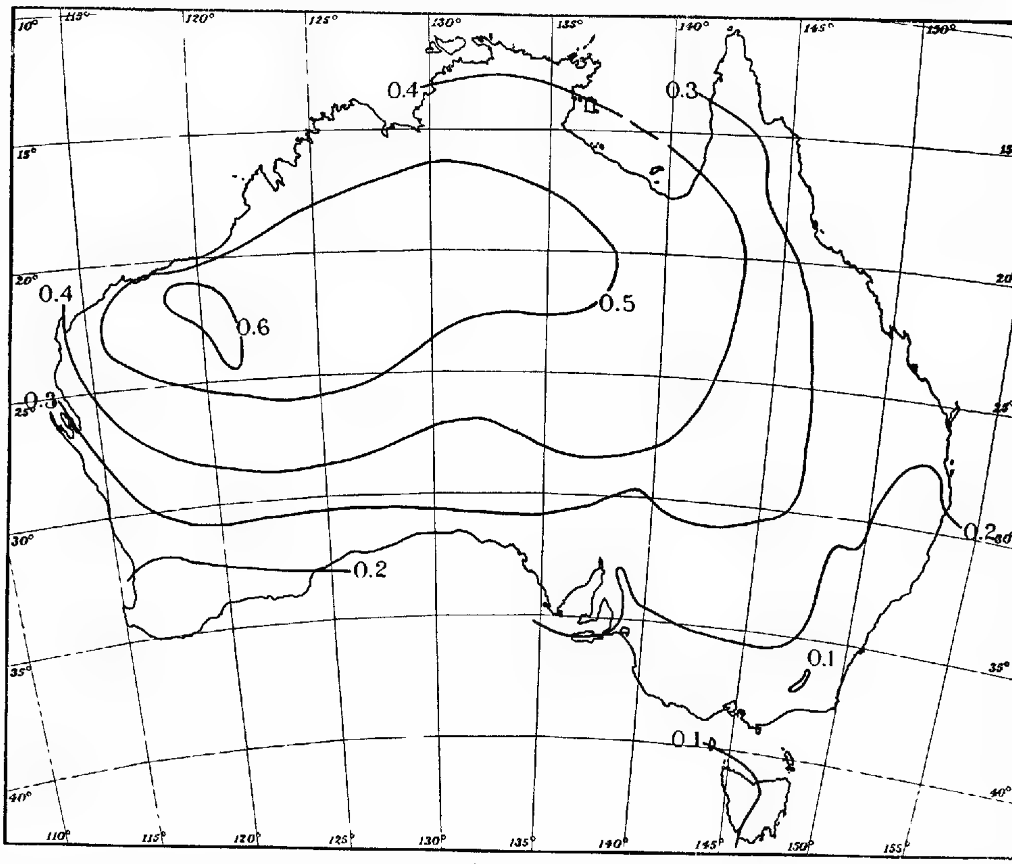

Fig. 2.

Map of Australia, showing isobars of vapour pressure saturation deficit expressed in inches of mercury. This deficit is roughly proportional to the evaporation from a free water surface, the general relationship being expressed by the equation $E = 263$ s.d. The values for the saturation deficit are based on the data of Fig. 1.

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ON MAMMALS FROM THE DAWSON VALLEY QUEENSLAND. PART I

BY H. H. FINLAYSON, HON CURATOR OF MAMMALS, SA MUSEUM

Summary

The earlier practice of Australian Museum staffs, in publishing accounts of collecting expeditions and of giving lists of mammals met with in various districts, seems largely to have been abandoned in recent years. As compared with the great volume of detailed information relating to the occurrence of birds, for example, published by the different Ornithological bodies, the data for mammals is sparse and infrequent, and, curiously enough, all the more important contributions on this head have been made by Europeans not resident in the country.

ON MAMMALS FROM THE DAWSON VALLEY, QUEENSLAND. PART I.

By H. H. Finlayson,
Hon. Curator of Mammals, South Australian Museum.

[Read September 10, 1931.]

Plates I. to III.

The earlier practice of Australian Museum staffs, in publishing accounts of collecting expeditions and of giving lists of mammals met with in various districts, seems largely to have been abandoned in recent years. As compared with the great volume of detailed information relating to the occurrence of birds, for example, published by the different Ornithological bodies, the data for mammals is sparse and infrequent, and, curiously enough, all the more important contributions on this head have been made by Europeans not resident in the country.

Australian workers seem to have been more and more content to confine their published records to occasional specimens of interest which have been submitted to them for identification, and, with a few early exceptions, regional surveys of the type which have made West European and North American mammalogy almost an exact science, are not undertaken.

This state of affairs is most unsatisfactory. It not only hampers a much needed campaign of museum collecting, intelligently co-ordinated, but the lack of local records has an embarrasing effect on the discussion of some theoretical problems, as pointed out recently by H. A. Longman and partly remedied by him. ("Mem. Queensland Mus.," vol. x., pt. 1.) On theoretical grounds, indeed, the need for a full and accurate statement of the constitution and distribution of the mammal fauna is obvious, and the frequent revision of this data is urgently required in determining the rational incidence and duration of protective legislation. As is absurdly apparent in some of the official lists which have appeared from time to time, the records of thirty, or even ten years ago, are not a reliable basis for determinations of the present status of species.

In the summer of 1928-29 the writer spent three months in the Dawson Valley, Central Coastal Queensland, for the purpose of observing and collecting mammals. The district was chosen, partly because it supports an unusually dense and varied Macropod fauna, in which group interest was chiefly centred; partly because far-reaching schemes of closer settlement are mooted there, which, if carried through, will render such a survey increasingly difficult and incomplete.

Collecting and investigation were carried out at numerous points along the Dawson and Fitzroy Rivers, from Taroom in the south to Mount Hedlow in the north. The region is a highly diversified one as to physical features, but as practically the whole of the country worked over has been excellently described and illustrated in two brochures issued by the Lands Department and Irrigation Commission, Brisbane, it will be unnecessary to give further description here.

Over the greater part of the area the Macropod element in the fauna is overwhelmingly dominant, and it is only in the more humid coastal zone to the north and east that the *Dasyuridae*, *Peramelidae*, and smaller *Phalangeridae* become numerous. This, together with the limited time available and the special interest cited, are responsible for the fuller treatment accorded the former, but, nevertheless, no opportunities were lost of obtaining both specimens and records of all, and the notes given provide a fair estimate of the present state of the fauna. The

material obtained by the writer in person has been usefully supplemented in many cases by specimens taken during the succeeding winter by friends resident in the area.

The most extensive collecting previously done in this part of Queensland is that of Lumholtz, who spent much time from 1880-1884 in the Rockhampton District in the northern portion of the area here dealt with, and whose collection was worked out by R. Collett in "Zoologische Jahrbücher," Band II., 1886-1887, p. 830, *et. seq.* Collett's work is a most comprehensive one on the systematic and osteological side, but is necessarily deficient in the all-important data which calls for personal observation in the field. In the present paper opportunity has been taken, not only of dealing briefly with habits (chiefly as they affect distribution), but of giving detailed flesh measurements and other observations from living or recently killed animals.

The comparative utility of these measurements and the methods of determining them will be dealt with more fully elsewhere; for the present they are sufficiently defined in "Trans. Roy. Soc. S. Austr.," liv. (1930), p. 55.

Macropus giganteus typicus (1) (Forester).

Widely distributed up and down the valley in suitable country, but never, in my experience, as plentiful nor forming such large groups as it does in New South Wales and Victoria. Near the towns and closer settlement areas, and in the sheep country, it is, of course, one of the first species to disappear, but in the great stretches of cattle country it is regarded very tolerantly, and is not being seriously pressed to maintain its position.

Few Australian animals have been so appropriately named in popular usage. From Tasmania north, over the whole of its range, it exhibits the same preference for open park-like forests where the floor is grassy and free from undergrowth, and the same shunning both of open plains and dense scrubs. In the Dawson Valley its typical habitat might be said to be the river flats of Moreton Bay Ash and Coolibah, but in several localities it is well represented in hilly country. This is notably so on the Grevillea Plateau, where it is rapidly becoming more plentiful as the adjacent lowlands are split up for closer settlement. These plateaus present rougher country than the flats, but they are yet quite openly timbered and well grassed, though with somewhat coarser species. Specimens were obtained at Box Tree Creek in the Taroom district, at Drumburle on the Grevillea Plateau, and at Coomooboolaroo, south of Duaringa, and they may be completely merged as Collett found, with representative series of skins from New South Wales and Victorian localities. There is some variation in coat colour, and the summer coat is short and harsh, but not more so than frequently obtains in the south. Winter skins have not been examined.

Flesh dimension of an aged male from Coomooboolaroo and a subadult female from Drumburle are as follows:—Head and body, 1,110, 835; tail, 1,165, 800; chest (girth), 660, 365; manus, 105, 80; nail of third finger, 38, 23; pes, 380, 320; fourth toe, 140, 125; nail of fourth toe, 50, 36; ear, 138 × 67, 125 × 68; rhinarium to eye, 116, 90; eye to ear, 80, 73; weight, 114½ lbs., 50 lbs.; humerus, 202, 110; ulnaradial, 235, 197; femur, 282, 220; tibia, 537, 380.

Skull dimensions of the above male are:—Greatest length, 195; basal length, 183; zygomatic breadth, 100; nasals, length, 85; nasals, greatest breadth, 24; depth of muzzle, 37; constriction, 24; palate length, 128; palate, breadth inside M^2, 33; anterior palatine foramen, 9; diastema, 60; basi-cranial axis, 49 (ca); basi-facial axis, 130 (ca); facial index, 265 (ca); Ms^{1-3}, 32·5.

(1) In indicating dominant varieties this usage is preferred, throughout the paper, to the repetition of the specific name.

Macropus giganteus melanops.

This well-marked variety of *M. giganteus* is the common kangaroo of the mallee belts of the south-eastern portion of the continent, and has recently been recorded for Queensland by Longman, though without detail as to locality *(loc. cit.)*. It was not observed in the area under consideration, nor could any evidence of its presence be obtained by enquiry amongst residents of long standing. As its external appearance is very different from that of the Wallaroo and Forester, its absence from the district may be safely assumed. It may be noted also that no scrubs of similar texture to the mallee are to be found along the Dawson.

Macropus robustus typicus (Wallaroo).

Numerically, the Wallaroo is the chief kangaroo of the district, and has a wide but sporadic distribution there. It is everywhere well known, and frequently plentiful, more particularly in the south.

Although it shows a preference for rough and rocky country, it is much less of a hill kangaroo than any of the more westerly sub-species I am acquainted with, and many of the higher weathered ranges with exposed outcrops and little timber (an environment which would be considered typical "euro" country in South and Central Australia) are quite deserted by it. This may be due, in part, to the flanking of these hills with more or less dense brigalow and softwood scrubs, which would tend to cut it off from the lower feeding grounds, but it remains true, I think, that its adaptations to a mountaineering life are somewhat inferior to those of the inland forms. In the country drained by the Downfall, Cockatoo, and Palm Tree Creeks, on either side of the Dawson, at the Nathan Gorge, wallaroos are very plentiful, and are here found on the little plateaus between the precipitous creek gorges—these tops are here quite thickly timbered often with *Callitris* thickets, and a love of such cover seems to be highly characteristic of the wallaroo. Further north, along the lower reaches of the Dawson, at Coomooboolaroo for instance, the country is much less rough and broken than in the upper districts, and the little ironstone ridges, densely grown with the lance-like rosewood, in which it is chiefly found, form a most unexpected habitat for any member of the *robustus* group. In fact, its habitat here in the north is scarcely differentiated from that of *giganteus,* for, though it camps amongst the rocks on the ridges during the day, its feeding grounds are practically identical or at least largely overlap those of the Forester.

It is rather solitary, and seldom more than two were put up together. Old males were always alone. Sexual differences as regards size, colouration, and general aspect are very marked. The full-grown male is in every way a most remarkable kangaroo, and in external features totally different from any other species. When seen at some distance, it appears quite black; the arms and shoulders are very heavy and powerful; it carries itself with an habitual stoop, and even when startled at close quarters never seemed to me to assume an altogether upright position. Its movements are slow and rather ponderous, and the coarse, shaggy coat and long pendant hairs of the sides of the face combine to convey a curious impression of uncouthness.

Old males are exceedingly tenacious of life, and will struggle away over rocks and frequently escape with wounds which would completely incapacitate *rufus* or *giganteus*. I noticed here, with the variety *typicus,* as I have often done with *erubescens* in South Australia, that the coat of the male when freshly killed is quite sticky, and on the ventral surface the skin and the base of the hairs have a distinct greasy deposit, not unlike the suint elaborated by sheep. The peculiar red pigment, so well known on *rufus* and recorded for this species by Le Souef "Aust. Zoologist," vol. v., p. 249 (1928), was not noted. (See, however, page 72.)

Unfortunately, no adult females were measured, but there can be no doubt that the does, even at full growth, are much smaller than bucks, and are quite differently built. Although without the heavy fore-quarters of the bucks, there is yet a suggestion of "dumpiness" about them, and they lack much of the trimness of *giganteus* and *rufus* does.

In referring the Dawson Valley wallaroo to *M. robustus typicus* some qualification is necessary, as a comparison of the skins obtained with others from the New England district of New South Wales brings out considerable differences in colouration, particularly in the males. These differences may be partly seasonal in character, as winter skins from Queensland have not been available (cf. Le Souef, *loc. cit.)*.

In the northern skins the dorsal surface of males is strongly suffused with red-brown, the bases of the hairs being of this colour, and their tips pure black. In the New South Wales specimens the general tone is a much colder slaty black, the hairs basally not being strongly contrasted with the tips, and a distinct bluish tinge being apparent on parting the fur. Collett *(loc. cit.)* noted that in specimens from Coomooboolaroo the tail was black, and this is a striking peculiarity of all the Dawson wallaroos. The whole of the tail, both above and below, from base to tip, is jet black, whereas in the New South Wales animal it is lighter below than above, and is nowhere quite black except at the extreme tip. The limbs are similar, but areas which are cream or honey-coloured in the southern animal are red-brown in the northern.

The female is closer to the typical form than the male, but is likewise distinguished by a pinkish suffusion approaching that of *erubescens*. Both sexes in the north have a harsher coat, and all hair tracks and opposition ridges are more marked, particularly about the face.

The skulls[2] agree closely with those from New England.

The external differences mentioned are probably as considerable as those which separate some of the so-called sub-species of *robustus*, but having noted the variations from the type and the locality in which they occur, there seems little to be gained by adding further to the list. The lavish application of names to the colour phases of variable species is of doubtful value at any time, and when it is done, as it very often has been done with marsupials, without the least knowledge of the animal in nature, it can scarcely command serious attention.

Flesh dimensions of an adult male (P^4M^4) from Coomooboolaroo:—Head and body, 985; tail, 1,000; girth of chest, 550; manus, 83; nail of third finger, 27; pes, 317; fourth toe, 115; nail of fourth toe, 35; ear, 125 × 65; rhinarium to eye, 100; eye to ear, 75; humerus, 155; ulnaradial, 240; femur, 265; tibia, 415.

The skull of this male has:—Greatest length, 180; basal length, 164; zygomatic breadth, 93; nasals, length, 74; nasals, greatest breadth, 29; nasals, overhang, 14; depth of muzzle, 36; constriction, 17; palate, length, 109; palate, breadth inside M^2, 29·5; anterior palatine foramina, 10; diastema, 40; basi-cranial axis, 48; basi-facial axis, 123·5; facial index, 256; molars $^{1-3}$, 30·5; P^4, 8·5.

Teeth in a young skull:—I^1, 5 × 10·5[3]; I^2, 4·5 × 6·5; I^3, 9·5 × 6·5; P^3, 7.

(2) On extending the comparison to *erubescens*, of which a large series of skulls has been available, I find that the anterior palate: diastema ratio, determined by Schwarz, holds good. In addition, the unworn molars of *erubescens* are slightly larger than those of *typicus*, and its muzzle region, even in very aged skulls, does not undergo that lateral bulging which in *typicus* approaches the normal condition seen in *antilopinus* (see Wood-Jones, "Mammals of S.A.," vol. ii., p. 251). I cannot agree with Mr. Le Souef, however *(loc. cit.)*, that these and some differences in colouration are of sufficient importance to warrant the separation of *erubescens* as a full species.

(3) Values for incisors are antero-posterior length × vertical height (of enamel).

Subgenus *Wallabia.*

From the point of view of the occurrence and distribution of the "Large Wallabies," the Dawson Valley is of great interest, as of the six existing mainland species, five are to be found within its confines, the single absentee being the isolated West Australian, *M. irma.*

This is true of no other district in Australia, and as the habitat zones of the different species, though for the most part well defined and discrete, constantly recur in close proximity to one another over the whole area, unique opportunities for the study of contrasting habits and general bionomics, are presented. These matters, however, can be touched on but very briefly here.

It may be noted that two species, *M. ruficollis* and *M. agilis,* find, respectively, the northern and southern limit of their range here.

Macropus (W.) agilis (Bunga).

This wallaby has long been known to occur on Stradbroke Island, off the mouth of the Brisbane River, and is the commonest large wallaby in North Queensland, but the extent of its range southward along the coast has been a matter of uncertainty. The most southerly occurrence definitely recorded appears to be that at Inkerman, in the Burdekin River district. [O. Thomas. P.Z.G. (1908), p. 703.] It was with some surprise, therefore, that the species was found to be fairly numerous and quite well known along the valley of the Fitzroy,[4] and within a few miles of Rockhampton, 320 miles further south.

It occurs sparsely on the lower grassy slopes of the Berserker Hills, but is more numerous in the long-grass flats which border the creeks, feeding the Fitzroy from the north, and, in particular, it was observed and specimens obtained on the Serpentine and Mount Hedlow Creeks. This is a country of more or less coastal characteristics, *i.e.,* both humidity and rainfall are higher than inland, and vegetation notably more luxuriant, and it is probable that it is confined to this coastal belt and does not penetrate inland to any extent. Whether it is to be found, at present, further down the coast I am not able to say from personal observation. If the "River" or "Grass" wallaby is actually *agilis,* however, then it certainly extended much further south as late as 30 years ago, as I had frequent accounts of it from men who knew the coast at that time. Mr. H. A. Longman, Director of the Queensland Museum, informs me that he has seen captive examples at Gladston; their place of origin, however, was not ascertained and was probably not local, as Mr. R. Vallis, a keen observer of the local fauna, who knows both the Rockhampton and Gladston districts well, assures me that he has never seen it at the latter place.

It does not occur along the Dawson proper. This southern representative of the species, in its short summer coat, is a very handsome wallaby, the ground colour of the dorsal and lateral surfaces being a rich, almost orange, buff, with but little pencilling of darker tips to dull the colour effect. The check stripe and hip stripe are strongly marked, the nape is more rufous than the back, and except that the toes show little darkening distally, both male and female agree well with *M. agilis jardinei,* as given by Schwarz.[5] [Ann. Mag. Nat. Hist., series 8, vol. v.,

(4) Not to be confused with a river of the same name in North-West Australia, from which *agilis* has been recorded and discussed by Lonnberg.

(5) The forms described by Schwarz are undoubtedly recognisable as colour phases, but whether they are valid in a geographic sense may be doubted. In going over considerable series of skins from the Kimberleys, Arnhem Land, Groot Eyelandt and the Queensland peninsula in my own collection, and in the S.A. Museum, examples agreeing more or less with *aurescens, agilis,* and *jardinei* are to be found from each place.

(1910), p. 164.] Winter skins subsequently obtained from the same locality, however, show a considerable increase in the grizzling of black and white hair tips, and this imparts a much greyer and colder tone to the coat. Both the male and female, taken in March, were strongly suffused over the whole ventral surface with a rich crimson waxy exudate, showing up conspicuously on the throat, chest, base of tail and inguinal areas. As already mentioned, this is a familiar feature in *M. rufus.* A. S. Le Souef has recorded it for *M. robustus, Petrogale rothschildi,* and *P. purpureicollis,* and I have observed it on old males of *giganteus typicus* (in February, Ryan's Creek, North-east Victoria), but I have not seen it previously on a brush wallaby, nor on a female of any other species. Certainly in *rufus,* and probably in all species, it is a seasonal feature and connected with heightened sexual activity, but the times of its incidence and maximum development have yet to be determined.

Dimensions of a subadult male (P^3M^3) and female (P^4M^3), shot together on the Serpentine Creek, are as follows:—Head and body, 725, 643; tail, 860, 770; chest, 390, 340; manus, 70, 52; nail of third finger, 29, 26; pes, 258, 233; fourth toe, 95, 85; nail of fourth toe, 29, 33; Ear, 91 $\times$48; 81 $\times$ 40; rhinarium to eye, 82, 80; eye to ear, 58, 55; weight, 39, 27 lbs.; femur, 202, 185; tibia, 288, 270; ulnaradial, 155, 134; humerus, 112, 95.

Skull measurements of a subadult male (P^4M^3), and an adult female from the Serpentine, follow:—Greatest length, 145, 139; basal length, 133·5, 126·5; zygomatic breadth, 77, 78; nasals, length, 64, 60; nasals, greatest breadth, 22·5, 23; nasals, overhang, 12, 11; depth of muzzle, 26·5, 24; constriction, 17·5, 16; palate, length, 91, 85·5; palate, breadth inside M^2, 26, 26·5; anterior palatine foramina, 8·5, 9; diastema, 37·5, 33; basi-cranial axis, 39, 36; basi-facial axis, 100, 94; facial index, 256, 261; molars $^{1-3}$, 27, 23; P^4, 9·5, 8·5.

Incisors in a young skull have I^1, 5 $\times$ 11; I^2, 4 $\times$ 5; I^3, 7·5 $\times$ 5·5.

Macropus (W.) dorsalis. ("Wallaby"; "Scrubber.")

Probably the most numerous and widespread mammal in the district, and, indeed in coastal Queensland generally, and usually referred to simply as the "Wallaby."[6]

Year in, year out, since the opening up of the country, it has been systematically snared and shot, but, in spite of the enormous destruction thus caused, its numbers are apparently little, if at all, diminished. Residents of long standing have pointed out to me quite small patches of scrub which have been closely snared every winter for 40 years, and in which the species is as plentiful as ever. Much the same may be said of *M. billardieri,* in Tasmania, and *M. eugenii,* on Kangaroo Island, South Australia, and it would seem as though the yearly "pruning" of these wallaby colonies, within limits, actually stimulates the rate of increase, possibly by removing aged males, which always form a large proportion of the catch at the beginning of operations.

In the Dawson Valley, and, I believe, over the greater part of its Queensland habitat, *dorsalis* has become sedentary and gregarious to a degree quite unapproached by any other large wallaby. A. S. Le Souef (Wild Animals of Australasia, p. 189) speaks of it being found in "South-Eastern Australia," in "rough, open country"; but in the area treated here it is absolutely confined to scrubs and jungles, and its mode of life is not definably different from that of the *Thylogale,* to which group, in fact, it seems allied by several structural features as well.

Over the greater part of the valley its typical stations are the great stretches of Brigalow scrub, which make up a large proportion of the total area. The pure

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(6) Further north this usage is transferred to *M. agilis,* according to Lumholtz.

Brigalow country, although containing dense stands of trees, has a fairly open floor, but more common are the Brigalow-softwood communities, in which growth is much denser through the development of a bushy undergrowth and interlacing vines. When this type of scrub is invaded by the prickly pear it is converted into practically impenetrable jungle, in which, however, the "wallaby" is still at home. In the wetter country towards the coast, on the Fitzroy, the Lantana thickets form its chief stronghold.

In habits it is shy and secretive, not given to daylight feeding, and, therefore, difficult to observe. Even in scrubs where it is numerous it is difficult to obtain more than fleeting glimpses of it as it retreats ahead of one down its runaways. It clings very closely to its cover, and I suspect that most of its feeding is done within the scrubs and that it does not rely to any great extent on the grass of the open country (in summer, at least). Although rarely seen in the open except in flood times, it has a well-marked trait in that it dislikes the dripping scrubs after rains, and at such times it will come out in numbers along the edges of the Bauhinia flats which frequently skirt the scrub in the lower country.

On inspection of the animal in the flesh, a number of minor external characters are to be noticed which may be added to existing descriptions. Attention has not been drawn, I believe, to the relatively very large size of the fore-limb—a most conspicuous feature in the general make-up of the animal. Not only is the whole limb very long, but the proximal segment is powerfully muscled and maintains its width almost evenly from shoulder to elbow. The arm is carried very straight at the side, with the two segments nearly in line.

The foot is small and slender. Three fully adult males give a mean value for its length of 205 mm., the lowest figure I have obtained (in flesh measurements) within the subgenus. The nail of the fourth toe is uniformly long, sharp-pointed, and unusually straight, the dorsal edge having practically no curvature.

Many examples of both sexes and differing ages were found to have failed in the development of the normal pigmentation of the soles of the feet, palms of hands, and rhinarium, these parts appearing either entirely flesh-coloured or irregularly mottled. The tail is more sparsely haired than in any other brush wallaby, and throughout the greater part of its length (in summer skins) the epidermal scales show through plainly. Gould's statement ("Mammals of Australia"), based on examples from The Namoi in New South Wales, that "it is distinguished from all other species by the greater length of the tail" is not applicable to the Dawson Valley animal. The ratio of, length of head and body : tail, in adult males[7] is there, as 1 : 1·14, a value which is exceeded by *irma* 1·36 +, by *parryi* 1·34, and by *ruficollis* 1·27.

The internal surface of the ear is bluish. On examining several hundred skins of *dorsalis* it is apparent that the general colour of the pelage and the development of the cheek, dorsal and hip stripes, are all subject to considerable individual variation. Comparison of a selection of these Dawson skins with others from South Queensland, indicates the existence of similar differences in these localities, which cannot be correlated in any definite way with either age or sex.

The seasonal change is marked. The coat becomes much denser and longer in the winter, and there is a marked intensification of the colour on the rufous areas of the fore-quarters and rump.

In all old males examined, the disposition of the hair tracts on the nape and shoulders is quite different from any other "Large Wallaby." The normal caudad tract takes rise, as usual, at a point near the occiput, but is greatly restricted in extent anteriorly by two areas of reversal which radiate from a point near the

(7) The relative length of the tail is less in females of all species of *Wallabia* examined.

armpit and cover the greater part of the scapular and nuchal surfaces with hairs directed cephalad. In a dorsal view the effect is very striking, since two converging opposition ridges are produced which, meeting the black dorsal stripe, form a sharply-defined arrowhead. (See fig. 1.)

In regard to its adult[8] dimensions and skull characters, *dorsalis* is remarkably variable, and this may perhaps be explained in terms of its varying adaptation or readaptation to a gregarious, sedentary life.

Detailed measurements of an aged male (P^4M^4) from relatively open Brigalow country on Spring Creek, in the Upper Dawson Valley, and the four conventional measurements of an adult female (P^4M^4) from a Lantana scrub, on the Fitzroy, are as follows:—Head and body, 720, 550; tail, 825, 580; girth of chest, 385; manus, 64; nail of third finger, 27; pes, 205, 157; fourth toe, 75; nail of fourth toe, 30; ear, 88 × 46, 83; rhinarium to eye, 78; eye to ear, 55; weight, 35 lbs.; femur, 180; tibia, 260; humerus, 136; ulnaradial, 175.

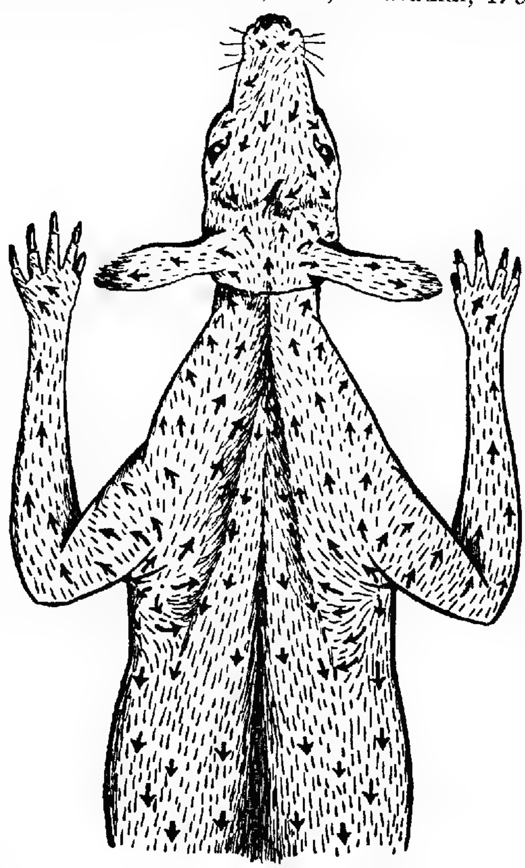

Fig. 1.
Dorsal surface of *M. (Wallabia) dorsalis*, showing the hair tracts. An aged male.

In the adult skull there is not only a great range of variation in size, in the shape of the nasals, the condition of the interorbital region, and of the temporal ridges, but there are frequent anomalies in tooth succession and some degree of asymmetry about the muzzle region is common.

(8) Throughout this paper the term "adult" is used as by Schwarz, for animals in which both P^4 and M^4 are in position, and not as by Thomas in the catalogue of 1888.

The mean values for skull dimensions of three males and two females (all P^4M^4) are as follows:—Greatest length, 135, 119·5; basal length, 121·5, 106·5; zygomatic breadth, 67, 58; nasals, length, 55, 44; nasals, greatest breadth, 21·5, 15; depth of muzzle, 22·5, 19;; constriction, 15, 15; palatal length, 80·5, 72; palate, breadth inside M^2, 23, 20; anterior palatine foramina, 7, 6; diastema, 33, 29·5; basi-cranial axis, 36, 33; basi-facial axis, 89, 76; facial index, 247, 230; M^{s1-3}, 22·5, 19·5.

The basal length for adult males may fall as low as 109 mm.

MACROPUS (W.) PARRYI (Whiptail).

This magnificent species still occurs in large numbers in suitable tracts all over the valley, but in the northern part of the area is rapidly diminishing. In 1884 it was obtained by Lumholtz near Rockhampton and on Coomooboolaroo, for instance, but is now quite unknown in the vicinity of the first place and on the second has become rare.[9]

It resembles the Toolache in spending the greater part of its time in very open country, and is more easily approached and observed than any other wallaby in the district. Typical of the whiptail habitats are the beautiful undulating upland parks of the broad-leafed ironbark *(Eucalyptus siderophlora)*—richly grassed and with frequent low, broken, rocky outcrops, bordered sometimes by wattle or Brigalow scrubs, but in themselves quite free from bush growth of any kind and with the trees rather widely spaced. As a characteristic example of this type of country might be cited the Grevillea plateau, where *parryi* is still in very large numbers.

Not only is its feeding done in such surroundings, but it makes its camps amongst the exposed rocky outcrops and is thus always more or less in view. It is rarely or never seen in a scrub. It is, no doubt, this fact of its frequently been seen amongst rocks which inspired the old name, "Parry's Wallaroo," but which a practical knowledge of both species proves to be unjustified, as except for an increase in the bulk of the toe pads, it makes no approach to *robustus* in structure. Its temperament also is quite different, and in no part of the valley was I able to examine whether their habitats overlap.

It is diurnal to a greater extent than any other brush wallaby, and except during the hottest weather may be seen feeding out in the open till 10 a.m. in the mornings and again after 4 p.m. in the afternoons, and in winter, I am informed by those who are constantly riding over its beats, it may be seen about all day. It is distinctly social in habit, and very likely truly gregarious, though it would take closer and more prolonged observation than I was able to give to determine the point. It certainly camps in rather large parties, 12 or 15 being frequently seen lying up together, but in the late afternoon, when feeding begins in earnest, there is a tendency, I believe, for the larger males and females to go off in pairs. At Drumburle, where I watched it most, they were so numerous, however, that towards evening whole hillsides were dotted with the members of these disbanded camps, and it was impossible to make out the existence of any natural grouping. Old males are always solitary, as in many other species.

The midday camps can be approached fairly closely, and are then seen to be most unrestful affairs; there is a constant preening and scuffling and changing of position, with interludes of playful sparring, much in the manner characteristic of *M. rufus.* In January there were no indications of rutting and females were taken with young in many stages, from almost independent "joeys" to naked embryos of 200 mm.

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(9) I am indebted to Mr. H. G. Barnard for the information that there are signs that it is recovering its former position in the Dawson Range on the southern end of Coomooboolaroo.

More than once, evidence was obtained of a degree of attachment between the sexes unusual in marsupials. On one occasion a young male (P^3M^2) and an older female (P^4M^3) were observed feeding alone in a gully. The male was shot, and the female immediately made off in a panic, but stopped at about 150 yards and looked back. Within a few minutes, not having seen me, she returned to the body of the male and, after circling it in a cautious and hesitating way, to my amazement, launched a violent attack upon it, striking repeatedly with her feet, springing back and striking again, with every appearance of rage and desperation. So engrossed in this was she that I was able to approach very close, and then perceived that her blows were solely directed at a great superficial wound on the flank of the male caused by emergence of the high velocity bullet.

It is well known that partially disembowelled animals will tear desperately at the extruded viscera with their teeth. In the case of kangaroos instances of it have frequently been told me by professional shooters, and I have observed it myself. My impression is strongly that in such cases the animal is mistaking the wound, or gut, objects which are entirely strange to it, for something which is altogether extraneous and which is responsible (by aggression) for their distress. In the above case, I have no doubt that it was the intention of the female to assist the male in beating off an attack.

Like so many mammals living in open country they are very curious, and their curiosity has earned them a reputation for stupidity amongst trappers and shooters. It is said by such, that in winter when large "mobs" congregate on the sunny side of ridges, a dozen may be shot down one by one before the rest make up their minds to go, provided the shooter does not move from his position.

Locally it is regarded as an extremely fast wallaby, but as it is not hunted with dogs to any extent, it is difficult to get data for comparison with other species. Although I never saw one hard pushed, my own impression was otherwise; it has, ordinarily, a rather loose-jointed, high-bounding gait, which would need to be greatly flattened out before it could extend a greyhound.

Le Souef ("Animals of Australasia") has already noted its habit of standing bolt upright, and the attitude he illustrates is in no way exceptional, but is always assumed when it leaves its feeding for a moment to look about it. Even the joeys rear themselves back in the same extreme way, and are often hard pushed to maintain their balance with their weak little tails—a most ludicrous sight. When in this upright position the hips are spread more than in other species, the femora apparently sloping outwards from the pelvis at a considerable angle.

Temperamentally it is not at all shy, and in captivity is mild and gentle in its ways. Old males have little of the aggressiveness shown, for instance, by *ruficollis* and *ualabatus*.

After examining many living examples at close quarters and measuring eleven in the flesh, the following details of external characters not apparent in museum material are to be observed. All writers have commented on the slender and graceful build of *parryi;* this is largely due to its great height, the unusually long neck and sloping shoulders, and the long attenuated forelimb; the hind-quarters being very large and powerful. Even in old males the slimness of the fore-quarters is not lost; the arms may become heavily muscled, but the wide chest and great development of pectorals commonly seen in "Old Men" of *ruficollis, ualabatus* and *agilis* is not usual in *parryi,* and its body weight is notably low in comparison with its linear dimensions.

The head, in addition to its striking markings, is peculiar in other respects; it is light and delicate, long and narrow, with a slender, shallow muzzle, pinched in at the sides somewhat, near the nostrils (see plates II. and III.). The ears,

as remarked by Collett *(loc. cit.)*, are unusually large; they are bent inwards at the tip, and their inner naked portions are salmon-coloured.

The pes is exceedingly large and with a naked sole, but this is not of even width, the calcaneal extremity being expanded. The toe pads are thick, fleshy and resilient. The nail of the fourth toe is large and strong and its upper edge strongly convex. The point is blunt, but is not undercut by an oblique facet of wear as in *robustus*. The fifth digit is relatively large, as in all *wallabia*, and is not reduced as in the wallaroos. (Compare Gould, quoting Strange, Mammals of Australia.)

The tail is a very striking feature, being excessively long, very mobile in life and with little lateral compression. Chevron callosities on its lower surface are not marked, but a large bare patch is generally present on the *dorsal* surface of the base of the tail.

As regards pelage, *parryi* appears to be a very uniform species all over its range; sexual, seasonal, and individual variations all being quite insignificant. Midwinter skins (August), when compared with those taken in January, show a slight increase in density on the ventral surface, but the dorsal coat remains short and rather thin and the colouration is precisely the same. It is a peculiarity of *parryi* that its epidermis, over the greater part of the body surface, is highly pigmented and appears a dark brown, or even black, on parting the fur. The coat of the fully-furred pouch young is exactly as in the adult. Hair trends generally are as in *ruficollis* (see "Trans. Roy. Soc. S. Austr.," 1930, p. 53). There is, however, in addition, a strongly developed opposition ridge on the haunch below, and nearly parallel to, the prominent white stripe in the same area.

In considering the future of this wallaby in Queensland, there are sound reasons for anxiety. It is true that it is still numerous over a large area, but no one with any knowledge of the fate of open country species elsewhere would maintain that it will long survive the present rate of slaughter in the cattle country of the Dawson. Where man is concerned its instinct for self-preservation is almost nil, and as its colouration and habits make it a most conspicuous animal at any time, its destruction is almost a mechanical matter. It is very probable that the scores of thousands of whiptails which are killed every year in coastal Queensland, represent, not the natural increase, as is assumed locally, but rather the natural drainage of the species from large areas of relatively poor feeding grounds into smaller areas which are more attractive to it and which will support a denser population. When the country is settled these "fur pockets" act as natural traps, and destruction which appears to be local actually affects a much wider area, indirectly. It is this factor of natural concentration which is largely responsible for the element of unexpected suddenness which often marks the extinction of mammal species before advancing settlement.

M. parryi is one of the most beautiful of Australian mammals, and is one of the very few species which can be easily and freely observed under natural conditions. It is to be hoped that its value will be recognised while there is still time.

Mean values for the flesh measurements of two males and two females, from Drumburle, and all with P^4 and M^4 in place, are as follows:—Head and body, 793, 732; tail, 1,077, 858; girth of chest, 470, 315; manus, 85, 54; nail of third finger, 33, 24; pes, 286, 247; fourth toe, 104, 94; nail of fourth toe, 32, 30; Ear, 105×53, 98×49; rhinarium to eye, 80, 75; eye to ear, 61, 53; weight, 49, 32 lbs.; humerus, 148, 100; ulnaradial length, 200, 155; femur, 225, 185; tibia, 330, 275.

All skulls examined show a close agreement in general features; from that of *ruficollis*, which it resembles closely when aged, it is distinguished by its narrower P^4, shallower muzzle, and greater transzygomatic breadth. In the Dawson area the skull is lightly ossified.

Mean values for the skull measurements of the above males and females are as follows:—Greatest length, 146, 137; basal length, 134, 124·5; zygomatic breadth, 75, 73; nasals, length, 61, 56; nasals, greatest breadth, 21, 21; depth of muzzle, 26·5, 23·5; constriction, 20, 19·5; palatal length, 89, 83; palate, breadth inside M^2, 24·5, 23; anterior palatine foramina, 6·5, 7·5; diastema, 38·5, 35·5; basi-cranial axis, 39·5, 36·5; basi-facial axis, 99·5, 91·5; facial index, 251, 250; $M^{s1\text{-}3}$, 23·5, 22·5; P^4, 5, 5.

MACROPUS (W.) RUFICOLLIS, var. (Roany: bush-tail).

So far as published records go, the northern extension of the range of this wallaby is very indefinite. It was stated by Longman in 1922 to occur in South Queensland, and somewhat later specimens were obtained by him from Mundu-berra, on the Burnett.

In the Taroom district of the Dawson Valley, in about the same latitude, but west of this locality, I had frequent reports of a "roan wallaby," or "bush tail," and finally, after obtaining a single specimen on the Palm Tree Creek, was able to identify it as *ruficollis*. It is not a common species on the Dawson, and I neither saw nor had reliable reports of it further north than Drumburle.

The single example obtained, a subadult female, was shot in a heavily-grassed gum flat, in just such country as is frequented by *agilis* further north.

Although its general external characters and skull and dentition are unmistakably those of *ruficollis,* its colouration is very distinctly, even strikingly different, from the southern form. On comparison with a young female taken in the Tumut district of New South Wales, about a month earlier, these differences may be summarized thus:—

The general dorsal colour is much lighter, and a marked cinereous tone prevails owing to the reduction in number of entirely black hairs, to the fading of the black terminal band of the other hairs to a rufous brown, and the consequent greater prominence of the subterminal white band. The black pencilling of all extremities is reduced. The hair at the base is everywhere some shade of ochraceous orange, whereas the epidermal band in the southern animal is a dark brownish slate. The rufous areas of nape and rump are similar in position and extent, but the colour is paler in the Queensland animal—almost buff. The muzzle, cheeks, and crown are a clear pale rufous, almost free from brown and black admixture, and, in particular, the back of the ears are uniformly coloured a pale buff orange, the extreme tip only being brownish; in the southern *ruficollis* the apical $\frac{1}{2}$-$\frac{2}{3}$ of the back of the ear is dark brown or black. The lower ventral surface is clothed with uniform cream or fawn-coloured hairs, very different from the dark slate silver-tipped hairs of the New South Wales animal.

The differences noted are quite as marked as those which separate the varieties *typicus* and *bennetti,* but I am unable to assert their constancy owing to lack of material. The accumulation of an adequate series has been undertaken, and pending its completion I refrain from giving this local form a name.

Flesh dimensions of the ♀ (P^4M^3):—Head and body, 618; tail, 727; girth of chest, 280; manus, 50; nail of third finger, 33; ear, 94 × 51; rhinarium to eye, 70; eye to ear, 53; weight, 24 lbs.; humerus, 78; ulnaradial, 132; femur, 175; tibia, 265.

Skull:—Greatest length, 130; basal length, 116; zygomatic breadth, 68; nasals, length, 53; nasals, greatest breadth, 18; nasals, overhang, 11·5; depth of muzzle, 24; constriction, 18; palate length, 77·5; palate breadth inside M^2, 22; anterior palatine foramina, 6; diastema, 27·5; basi-cranial axis, 33; basi-facial axis, 85; facial index, 258; $M^{s1\text{-}3}$, 24·5; P^4, 7; I^1, 10 × 5; I^2, 5 × 3·5; I^3, 6 × 8.

MACROPUS (W.) UALABATUS, var. INGRAMI. (Swamper.)

This species is found throughout the length of the valley, but has a very interrupted and rather sparse distribution. It was observed and specimens obtained, in the Taroom district, at Thangool in the Callide Valley, at Coomooboolaroo

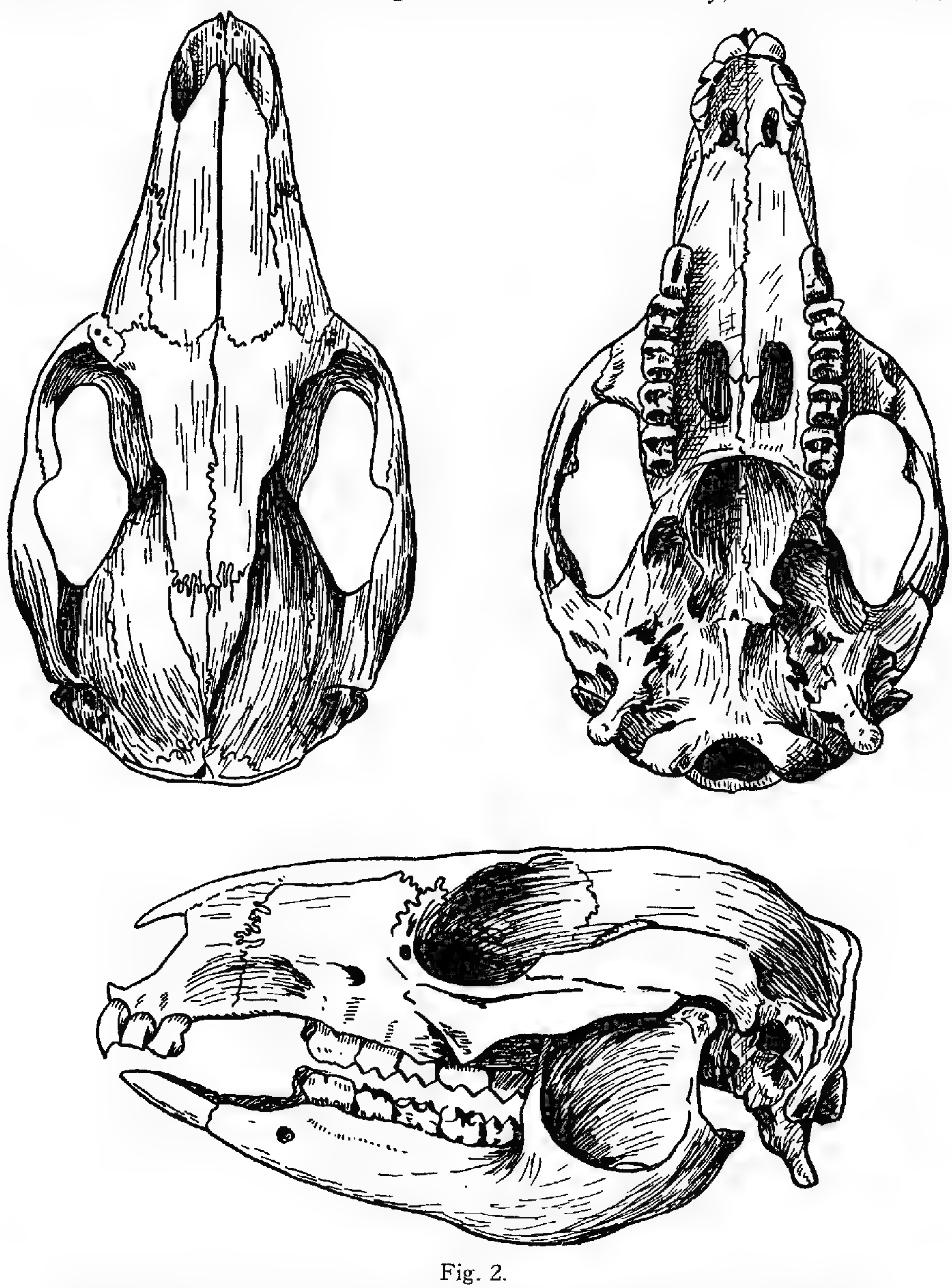

Fig. 2.
Superior, palatal and lateral views of the skull of *M. (wallabia) ualabatus ingrami.* Adult male, from Thangool. Three-quarters natural size.

and in the Berserker Hills, but in many intermediate localities, where it was sought in likely country, it was quite unknown. Further east, on the slopes of the Coast Ranges, its habitat is one of well-watered, densely-clothed and shady gullies, which,

except for the increased humidity, offer conditions quite similar to those obtaining in Gippsland and southern New South Wales, where the typical variety has its chief station. On the Dawson it has to contend with much drier conditions, and the *ualabatus* element in the fauna here, probably represents only the scattered (and fluctuating) fringe of the main body. In some places its first appearance is still remembered. Mr. Charles Barnard, the present owner of Coomooboolaroo, remembers when the first "black wallaby" was taken by the local blacks (in the early eighties) in the Dawson Range at the south end of the run, and brought in to the homestead and exhibited by them, as a great curiosity. It lives very obscurely in small scattered parties and lies up in moderately dense cover. At Thangool, where it was rather more plentiful than elsewhere, it camped on the fringes of the Brigalow scrubs and was snared on the same pads as were used by *dorsalis,* but unlike the latter it was frequently seen in the early mornings about the clearings of the settlers, feeding on the Rhodes grass.

The material obtained agrees well with Thomas's description[10] of *M. ualabatus ingrami* from Inkerman, 300 miles north of the most northerly locality from which I obtained specimens.

It is a small brightly coloured form of *ualabatus,* characterised by a great increase in the fulvous element of the colouration. The subterminal band of the dorsal hairs is longer than in *typicus,* is pale gold yellow rather than orange rufous, and the overlay of entirely black hairs is much reduced. The face markings are conspicuous, the coat shorter, and although its colours are brighter the hairs lack much of the lustre and sparkle of the southern form.

The skull is smaller than that of *typicus,* aged examples attaining a basal length of 113 mm. as against 128 mm. In general proportions and contours it is similar to that of the southern variety, and, like it, is massive and densely ossified. Significant of relationship, also, is the practical identity in size and proportion of male and female crania—a striking peculiarity of *ualabatus typicus* separating it sharply from other eastern species.

Minor, but constant, differences separating the two varieties are: (1) the relatively greater posterior expansion of the nasals in *ingrami,* the ratio length ÷ posterior breadth being only 2·36 as against 2·80 in the south; (2) the virtual absence in *ingrami* of the interorbital constriction, always very marked in mature skulls of *typicus;* numerically expressed, the ratio, basal length ÷ constriction is 6·0 in the former, 7·6 in the latter; (3) the diastema (at comparable dental stages) is shorter in *ingrami,* going into the basal length 4·8 times, as against 4·5 times in *typicus.*

The teeth, particularly the secator, are smaller and lighter in *ingrami*—considerably more so than linear dimensions alone indicate.

Unfortunately detailed flesh measurements of adults were not obtained.

The mean values for the dimensions of four adult skulls (P^4M^4) are as follows:—Greatest length, 119; basal length, 109; zygomatic breadth, 61; nasals, length, 46; nasals, greatest breadth, 19·5; nasals, overhang, 9; depth of muzzle, 23·5; constriction, 18; palate, length, 70·5; palate, breadth inside M^2, 21; anterior palatine foramina, 6; diastema, 22·8; basi-cranial axis, 33; basi-facial axis, 79; facial index, 239; P^4, 8; Ms^{1-3}, 20·5.

The maximum values for the teeth, derived from a series [11] of 8 *ingrami* and 15 *typicus* skulls are:—I^1 *(ingrami),* 4·5 × 9·5, *(typicus),* 4·5 × 9·5; I^2, 5·5 × 5·5, 5·5 × 6·5; I^3, 7·5 × 6·5, 8·0 × 6·5; P^3, 6·5, 7; P^4, 8·5, 10; Ms^{1-3}, 22·5, 23·5.

There can be little doubt that this wallaby is identical with Krefft's *Halmaturus mastersi,* obtained in about the same latitude on the Burnett in 1870.

(10) "P.Z.S.," 1908, p. 792.

(11) Antero-posterior length × vertical height (of enamel).

The name *mastersi* was given as a doubtful synonym of Günther's var. *apicalis,* by Thomas in 1888, and when the Inkerman specimens were examined in 1908 Krefft's name was again suppressed, presumably on the grounds of insufficient description.

Although it would be seemly to commemerate Krefft's priority in the matter, there appears no regular way of so doing, except by founding a new subspecies on such trifling differences as can be made out between the Inkerman and Dawson animals, and this is a very undesirable course.

It may be noticed, as an apparent anomaly, that the reduction in size of *ualabatus,* which occurs on passing from Gippsland to Central Queensland, is not continued further north; *apicalis,* from Cape Grafton, being (fide descriptions) as large as the typical form.

Subgenus *Thylogale.*

The local distribution of the small wallabies of this group in the Dawson Valley is a matter of uncertainty, owing to the fact that its presence is usually masked by the much more numerous *M. dorsalis,* which has come to occupy almost all the scrubs in which *Thylogale* might be sought. In most localities where *dorsalis* is taken in large numbers for commercial purposes, the snarers tell of a much smaller "Paddymelon" which they obtain occasionally. From its description I would identify it with *M. thetidis* or *M. wilcoxi* rather than with *Onychogale frenata,* to which, according to Longman, this vernacular name is most commonly applied in Queensland.(12)

It is, at any rate, quite certain that numerically *Thylogale* are an insignificant factor in the fauna of the Dawson Valley proper, and the only specimens which were obtained came from the moister country on the Fitzroy.

MACROPUS (THYLOGALE) WILCOXI (?). . .

Three examples of a "small wallaby" were obtained in the Berserker Hills, where they were called "Paddymelons" by local naturalists who considered them rare, and as no *Thylogale* are listed by Collett, in spite of Lumholtz's long stay in the Rockhampton district, its rarity is not apparently a recent development. The three specimens are practically identical, and present such a mingling of the characters of *thetidis* and *wilcoxi* (as recorded) that the identification given is provisional only. Material for direct comparison has been scanty, and existing descriptions are confused and appear to be based on quite inadequate numbers from restriced localities.

In a general view the skins are nearer *thetidis* than *wilcoxi,* having the characteristic rufous nape and fore-quarters, a marked reversal of the hairs cephalad on the anterior dorsal area, and uniformly coloured ears, with no indication of the bright rufous basal patch of the New South Wales *wilcoxi.* On the other hand, the posterior and outer aspects of the lower leg and tarsus are bright rufous strongly contrasted with the grey brown of the upper leg and the pale brown of the foot and toes. In a series of *thetidis* skins from the Northern Rivers district of New South Wales there is no approach to this character, and Gould's plate of *thetidis* represents the whole of the leg as being uniform grey coloured. Thomas, in the catalogue, speaks of the arms and legs being grey or rufous. There is a faint pale hip-stripe.

The skull, on the whole, is nearer *wilcoxi* than *thetidis,* but this decision is based almost entirely on the dentition. On applying the tests given by Thomas for distinguishing the two species, to such skulls of both as are available here, it

(12) The word "Paddymelon" is of very uncertain connotation in all the States, and in the writer's experience is applied to at least eight species of marsupials. It is frequently used by bushmen, in a general or categorical sense, for animals which are strange or unfamiliar.

would appear that the characters relied upon (except those of the teeth) are so variable in both as to be quite useless for the purpose. This is true of the nasals, premaxillae, interorbital space, palatal foramen, and nasal spine.

The third incisor, however, is a considerably larger tooth in *thetidis* than in *wilcoxi*, and its anteror posterior length is distinctly greater than its height, whereas in *wilcoxi* the length is about equal to the height, or rather less. Both secator and molars are somewhat shorter and slighter in *thetidis*.

In these respects the Berserker wallaby agrees with *wilcoxi*, and as they may be given more weight than discrepancies in coat colour, I refer it to that species rather than to *thetidis*. It is plain, however, that a systematic restatement of the characters of these two small wallabies, based on a large series culled from the whole of their range, is urgently needed.

No flesh measurements were obtained, but both sexes at the P^4M^4 stage are smaller than either *thetidis* or *wilcoxi* from northern New South Wales.

Skull dimensions of a male and female, both with P^4M^4:—Greatest length, 94, 87; basal length, 86, 78; zygomatic breadth, 51, 46·5; nasals, length, 35, 31; nasals, greatest breadth, 15, 13·5; nasals, least breadth, 7·5, 7; nasals, overhang, 4·5, 3·5; depth of muzzle, 18, 15; constriction, 11·5, 11·5; palatal, length, 54, 49; palatal, breadth inside M^2, 16·5, 15·5; anterior palatine foramen, 4, 3·5; diastema, 18, 18; basi-cranial axis, 29·5, 25·5; basi-facial axis, 58·5, 53·5; facial index, 198, 209; $M^{s\,1\text{-}3}$, 15·5, 15·5; P^4, 5·5, 5·5; I^3 (in a young skull), 6 $\times$ 5·5.

Petrogale penicillata, var. herberti.

This rock wallaby is still, as in Lumholtz's time, very numerous and widely distributed. It is to be found in thriving colonies in almost every range of hills away from the large towns, and occurs indifferently whether the rock outcrops are bare or densely clothed with scrub. Like the local wallaroo, it is considerably less specialized to a life amongst rocks than some of the inland forms, and on the upper Dawson, in the broken country round the heads of the creeks, it spends much time in the patches of low scrubs, living much as the *Thylogale* do. Like them, also, it is less diurnal and more wary than *P. xanthopus* or *P. lateralis*, and although it takes the sun on the rock faces in the early morning and again in the late afternoons, it does not expose itself as freely as the latter.

In spite of its black and white axillary patches and stripes it is not at all conspicuous, and in life appears a very plain, unadorned little wallaby. The general form is squat and dumpy with short, strong arms and legs, and the males become very heavy and strong about the arms and chest. Its physiognomy is very peculiar. The head (pl. i., figs. 1 and 2) is short, and at the crown is deep from above downwards, and wide from side to side. The short ears are thus set far apart, and the inter-auricular distance nearly equals the length of the ear. The rock wallaby is the only macropod in the Dawson Valley which is totally protected by law, and (possibly on this account) is regarded with little favour by settlers, and is shot freely. It is unlikely, however, to suffer any material diminution in the near future.

A series of eighteen skins from four localities in the valley, representing a north and south range of about 170 miles, has been examined. The series presents characters which agree essentially with Thomas's description of *P. herberti* ["Ann. Mag. Nat. Hist.," series 9 (17), 1926, p. 625], and one of the Westwood specimens examined by him has been available for comparison and blends perfectly with the rest. It is plain, however, that there is a much wider range of individual variation in external characters than might be inferred from the original description, and of these differences the following may be noted:—(1) The degree of tawny suffusion on the dorsum varies greatly both in extent and intensity; a point of some importance as affecting its distinction from *assimilis*. (2) The

white vertical band behind the scapular and the black axillary patch are frequently prolonged posteriorly, so as to form parallel longitudinal stripes reaching as far as the knee. In two summer skins this is almost as marked as in the central

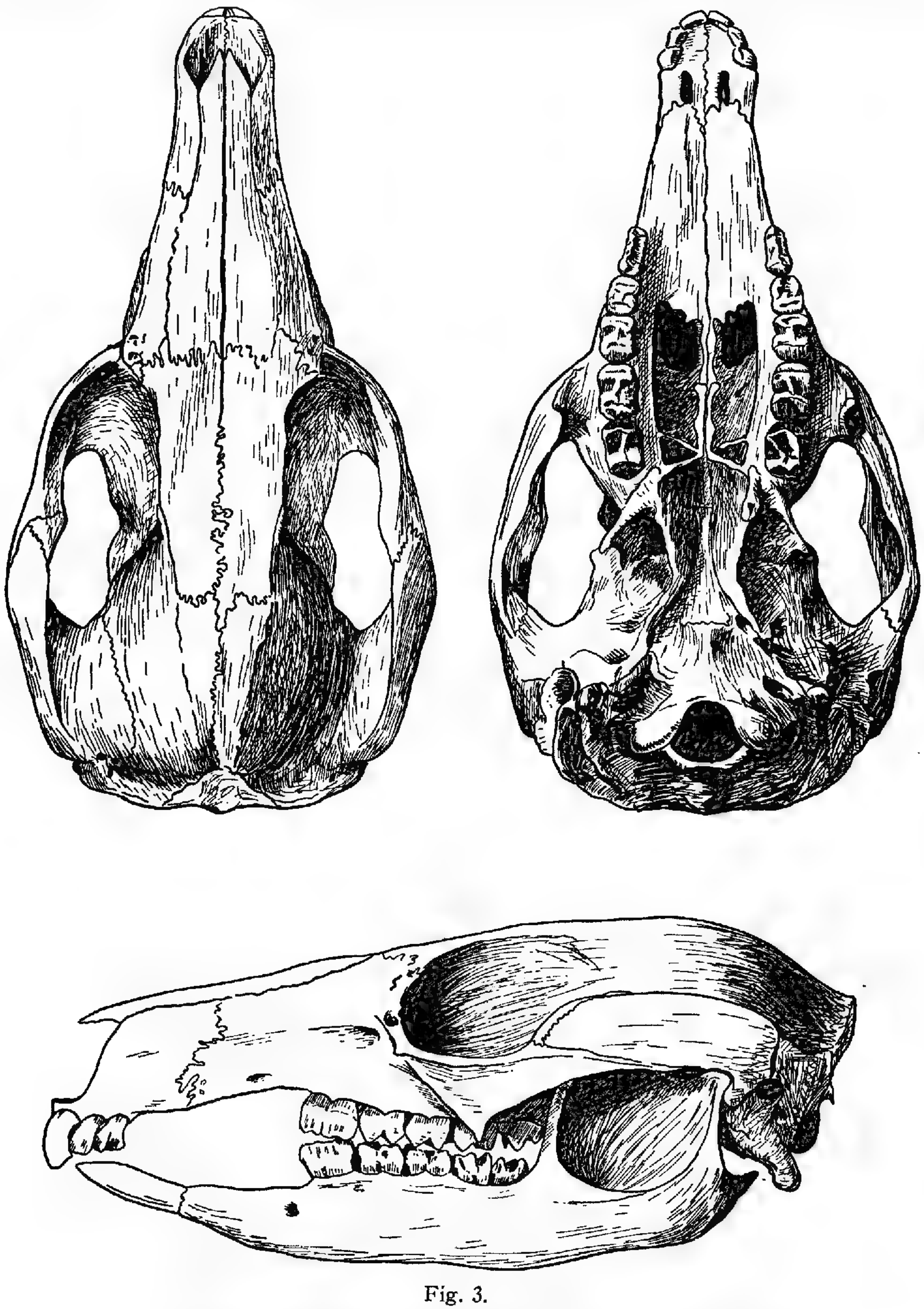

Fig. 3.
Superior, palatal and lateral views of the skull of *Petrogale penicillata herberti*. Adult male from Mount Hedlow. Slightly enlarged.

lateralis, but in others is but faintly developed. The nuchal stripe is also variable. (3) The colour of the forearm is generally some shade of yellowish brown, but may be yellowish white, and is then not distinguishable from that of the single *assimilis* available. (4) The tail may be quite black for three-quarters of its length (as noticed by Collett), or the black may be confined to the last inch or so, the remaining portion of its length between the tip and basal patch being either a grizzle of black and tawny, or almost uniform buff. Any distinction from *penicillata* or *assimilis*, based on this feature, can be of little value. All black areas tend to become orange brown. The bushiness of the tail varies a great deal; in some the hairs reach 55 mm., in others the longest hairs on the tail are but 15 mm. (5) The ventral surface, which is a variable mixture of grey-fawns, is commonly blotched with pure white. There are indications of this in specimens from all four localities, but at Morinish, 30 miles north-west of Rockhampton, it is especially pronounced, and the rock wallabies there are white-chested or even white-bellied.[13] (6) The tawny suffusion of the lower back is largely determined by the showing through of the brownish tips of the under-fur. In addition to the variability of this feature, striking differences in general appearance are also brought about by a change in the colour of the tips of the guard hairs from black to orange rufous, a much brighter colour than the normal tawny. In such specimens the dorsal colour approaches *Peradorcus*.

The series examined is a comprehensive one of about equal numbers of males and females, taken in February, March, June, August and October, and in several developmental stages. In spite of the wealth of data which it presents, I find it impossible, after careful comparisons, to correlate these variations in any definite way with locality, sex, age, or season. Some of the differences noted are, no doubt true individual variations, but others, particularly the intensity of tone and colour, prominence of markings, and texture of the pelage, probably represent merely passing phases of a cycle of change which do not synchronise in different individuals. The change of black hairs to red, for example, occurs in young as well as aged individuals of both sexes, and is quite independent of season. The two skins which represent most strongly the erythristie and cinereus stages were both taken at Mount Hedlow in June from males at the same dental stage.

The single seasonal feature which occurs in all is the great increase in density of the coat, particularly of the rich brown-black under-fur.

The skull (fig. 3) is rather variable in adult size (basal length, 100-107 mm.). As compared with the central forms, it is strongly built and densely ossified. Especially characteristic and unvarying is the wide posterior margin of the nasals; the naso-frontal suture, although very sinuous in its course, being almost transverse in its direction.

Collett's notes *(loc. cit.)* on *P. penicillata* relate to this form.

In his investigation of the *penicillata herberti, assimilis* group, Thomas has had large series of recently collected material upon which to work, and his conclusions are backed by such unique experience in these matters that one cannot doubt that the three types are recognisable, although it is plain that the distinctions relied upon are somewhat trivial, and (in the case of the northern pair) by no means constant even in a limited area, and, as Thomas himself admits, are average rather than individual characters.

In regard to the degree of separation to be accorded the forms in classification, however, there is room for other opinion. The recent description of ten new rock wallabies as full species is based on altogether insufficient knowledge and is

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(13) Mr. R. Vallis, a local naturalist, first drew my attention to this peculiarity, suggesting that the form is distinct from that further south. He was not aware, however, that the white blotching occurs in other places, and, as the Morinish wallaby is otherwise quite similar, I cannot share his opinion.

a most regrettable course, not only by reason of the confusion which is introduced in identifying such closely related forms, but more particularly on account of the lack of balance which then exists (in the literature) between these suddenly expanded genera and those which have, for purely fortuitous reasons, escaped the attentions of nomenclatorial enthusiasts. As varieties, most of these new forms would be sufficiently made known, without doing violence to the real distinctions of structure, habits and range, which separate the older species.

As Pocock has recently said ("Proc. Royal Soc., London," 1930), Thomas, in his later work, seems to have used the word species in a purely geographic sense, but even in this reduced form it cannot be applied to the *penicillata* trio, since the highlands which they occupy extend practically unbroken over the whole of their range, and the factor of isolation is absent.

For these reasons I would refer the Dawson Valley rock wallaby to *Petrogale penicillata herberti.*

Flesh measurements of an adult male and subadult female (P^4M^3) from Spring Creek, in the Taroom district, are as follows:—Head and body, 535, 515; tail, 650, 580; girth of chest, 265, 220; manus, 47, 42; nail of third finger, 12, 11; pes, 162, 157; fourth toe, 84, 78; nail, 14, 13; ear, 62 × 32, 61 × 32; rhinarium to eye, 61, 52; eye to ear, 45, 40; weight, 13 lbs., 11 lbs.; humerus, 73, 63; ulna-radial, 100, 87; femur, 145, 137; tibia, 186, 173.

Mean values for the skull measurements of 5 males and 3 females, all adult, are:—Greatest length, 108, 100; basal length, 93, 87; zygomatic breadth, 56, 53; nasals, length, 45, 42; nasals, greatest breadth, 13, 12·5; nasals, least breadth, 8, 6; nasals, overhang, 6. 5; depth of muzzle, 18, 16; constriction, 14·5, 14·5; palatal length, 60, 56; palate, breadth inside M^2, 16, 16·5; anterior palatine foramen, 6, 4; diastema, 18·5, 17·5; basi-cranial axis, 28, 26; basi-facial axis, 67, 63; facial index, 234, 234·5; $M^{s\,1-3}$, 17, 16·5; P^4, 7, 6·5.

Maximum values for the teeth derived from the series of 18 skulls are:— $M^{s\,1-3}$, 20; P^4, 7·5; P^3, 5; I^1, 4 × 8·5; I^2, 3·5 × 5; I^3, 4·5 × 5.

Onychogale frenata.

Observed twice only, and no specimens obtained. It was obtained by Lumholtz in the Rockhampton district in 1880-1884, and recently Longman *(loc. cit.)* has stated that it is not uncommon in South Queensland. Over the greater part of the Dawson country, however, it is either absent or rare, as few reliable accounts of it could be obtained.

Lagorchestes conspicillatus.

Neither specimens nor reliable accounts of this animal were obtained.

It was collected by Lumholtz 200 miles north-west of Rockhampton, and later was recorded by Thomas from Inkerman (1908).

Subfamily POTOROINAE.

Aepyprymnus rufescens.

This interesting animal, though highly characteristic of coastal Queensland, has received very little mention in recent years, and there has been no published data from which one might estimate its position in the fauna of that State.

Strangely enough it was not taken by Lumholtz, though it must have occurred in many of the districts in which he worked, and has thus escaped the searching examinations of Collett. It has been twice recorded from North Queensland localities by O. Thomas ("P.Z.S.," 1908, p. 788, and "Ann. Mag. Nat. Hist.," 1923, ser. 11, p. 170), and by Lönnberg and Mjöberg from Carrington ("Kungl. Svenska

Vetenskaps Akadamiens Handlingar," Band 52, No. 2, 1916), but without comment, and as each record was based on a single individual, it might be inferred to be comparatively rare.

In the Dawson and Fitzroy Valleys, however, this is far from being the case, and it is widely spread over the whole area from sea level to the tops of the plateaus. It occurs in almost all types of country, both open and forested, but never, apparently, in dense scrubs, and, like the Bettongs, it has a preference for grassy lands free from bush growth. The banks of creeks and river flats are favourite resorts, and there are few such places which by systematic beating cannot be made to yield up a few.

The nature of the country is such that it is seldom far from surface waters in normal times, and it does not hug the watercourses so much for the water as for the long grass which lines them. When, however, surface waters fail it suffers severely. Like most of the coastal species it has little resistance to drought, and will go to great lengths in excavating holes in dry creek beds to get down to water level. In January, 1929, the Cariboe Creek ceased to run at Thangool, and for miles the sandy bed thus exposed was criss-crossed with the pads of *Aepyprymnus* coming down at night to drink at pot holes of their own making.

In the cattle country it is stated by squatters to have diminished considerably in recent years, and by them it is regarded with indifference. But round many of the newly-formed cotton settlements in The Callide Valley it is plentiful, and at Thangool and Biloela and other points on The Cariboe has become an unmitigated nuisance and is cordially detested by the struggling settlers. Its raids on the crops are determined and resourceful, and as no ordinary fence will bar them for long, poisoning is the only effective check. Scores of thousands have been killed in this way, and skeletons (few and far between in Museums) are littered thickly round the cotton plots.

It is almost strictly nocturnal, and even where plentiful is seldom seen in daylight unless it is driven from a "camp." It is solitary in habit and adult males and females are not often put up together, though a female is often accompanied by a nearly full-grown young.

By most authors (quoting Gould?) it is stated to build a grass nest, but in spite of much searching in likely places none were found, and nest making may possibly be a winter industry only. It is not at all fast and is easily caught by a good dog in the open, but is an expert dodger and (as all accounts of the New South Wales animal state) makes immediately for a hollow log, if such is available.

When cornered it remains cool and fights with a deliberate and collected fury, very different from the panic usually displayed by wallabies in a similar case. When taken in box traps or snares it is a most difficult animal to handle, as it is immensely strong and active and bites and claws severely. The long rodent-like incisors are not sharp enough to make large gashes, but they are difficult to dislodge, as the animal grips with all its strength and holds on, and a painful bruised wound results.

When taken young it becomes tame and affectionate, if gently handled. Its ways, even in confinement, are full of interest, and convey, as do those of all the *Potoroinae*, a much greater impression of versatility, resource, and intelligence than is the case with the more specialized *Macropodinae*. It is capable of most unexpected movements, and is not without a sense of play. A pet which I observed at Rockhampton, when teased by tossing towards it an empty 4-ounce tobacco tin, would, while lying on its side, kick it back high in the air, with *one* foot. This it did repeatedly, changing position very neatly when the tin was thrown in from a new angle.

At night it has little fear of man, and the strange sights and sounds and smells of a bush camp can always be relied on to attract it, and if it has not been

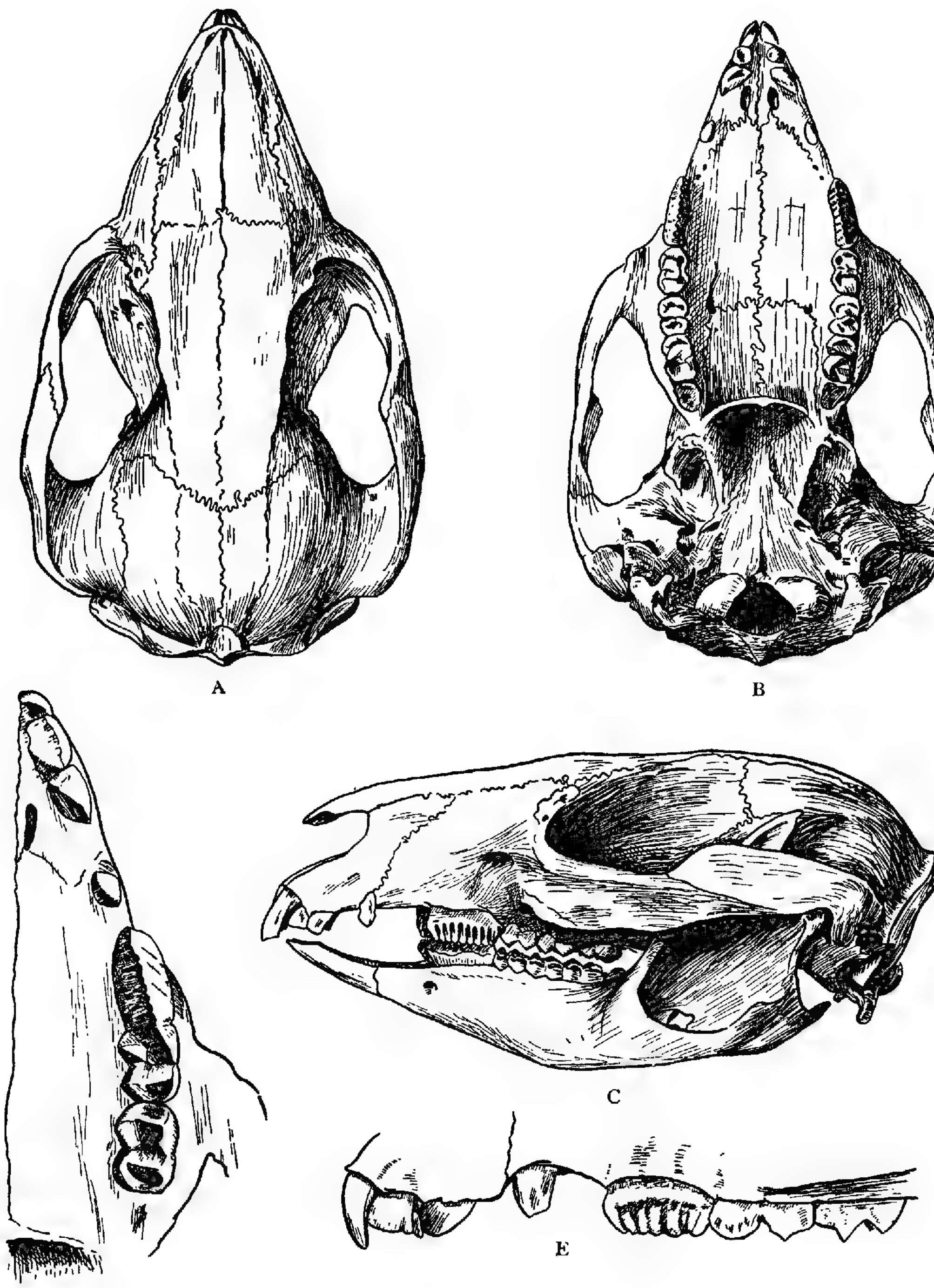

Fig. 4.

A, B, C.—Superior, palatal and lateral views of the skull of *Aepyprymnus rufescens*. A subadult female, from Thangool. Natural size.

D, E.—Palatal and buccal views of the teeth of *Aepyprymnus rufescens*, showing the characters of the incisors and the trenchant modification of the deciduous premolar (MP^4). An immature male; 1·7 times natural size.

molested by dogs it can be enticed up to a tent door to receive scraps of food. Though largely rhizophagous under natural conditions, it becomes almost omnivorous in captivity and apparently thrives so.

When on the move it makes, at frequent intervals, a grunting sound similar, but not identical, with that of *B. penicillata.*

In March, February and January females were taken with naked pouch embryos up to 100 mm. in length.

Of external characters noted in the flesh the following may be mentioned. Bodily size at the P^4M^4 stage is rather variable, the head and body measurement fluctuating from 360-390 mm. and the pes from 130-140 mm., but contrary to Gould's statement, I find that females are appreciably larger in linear dimensions than males and are very considerably heavier (see measurements). It is not only a bigger animal than any of the Bettongs, but is relatively stouter and more strongly built, and the limbs, head, and tail are more massive. The tail is either equal to or shorter than the head and body, never longer, and it gives no evidence on inspection of a prehensile capacity or usage.

In the characters of the head it is quite different from *Bettongia cuniculus* and *B. penicillata,* but approaches *B. lesueuri* [14] in the short, rather blunt muzzle, round staring eye, and bold, insolent expression. All sets of facial vibrissae are present, but are feebly developed. All are black.

The soles of the feet, and palms of hands, are broadly naked without lateral infringement of hairs, and these parts, and all claws and the rhinarium are pale horn-coloured with no trace of black pigmentation, such as occurs frequently in *Bettongia* and *Potorous*. The inner naked portions of the auricle, on the other hand, are coloured bright orange or salmon.

In several specimens examined, the cloaca showed a heavy infestation of a dung-eating beetle.

In general the characters of the *pelage* are very constant, the texture of the fur, colouration, and markings being almost exactly the same throughout the series of 14 skins examined. They agree well, also, with the existing descriptions of the animal, all of which appear to be based on New South Wales examples. Gould's plate, however, although reproducing the gradations of colour faithfully, is too sombre in effect and does less than justice to the bright silver and russet tones of the living animal and its fresh skin.

The dark pencilling of the tail shows some variation in extent, sometimes being continued distinctly to the tip, sometimes fading out and leaving varying lengths of its distal portion pure white.

Young animals, at the P^3M^1 to P^3M^2 stage, have a denser under-fur than adults, and the characteristic black ear back is not fully developed, the contrasted area being dark rufous.

The sexes are identical, and the seasonal change, at least in adults, is negligible. Except for a gular reversal, the hair tracts retain everywhere the primitive cephalo-caudad and proximo-distad directions.

The furred pouch young, at the 350 mm. stage, is very different from the adult. The coat is harsh, closely adpressed, glossy and brilliantly coloured. The head and greater part of dorsum are a rich uniform dark rust colour, abruptly contrasted with a pure black and white grizzle on the post sacral and femoral areas.

Fourteen skulls have been examined and measured, representing stages from P^3M^1 to P^4M^4. Apart from trifling differences in the shape of the nasals, the series is a uniform one. The skull rapidly assumes a very dense ossification as growth advances and is relatively much heavier than in any other of the *Potoroinae.* No anomalies in tooth succession are presented, and no supernumerary molars are developed as they frequently are in *Bettongia.*

(14) See Wood-Jones, "Mammals of South Australia," vol. ii. p. 207.

The secator[15] appears to come into place shortly after M^3, at a stage when the general dimensions of the skull are already approaching their maxima.

In the incisor series a number of characters are presented which, though foreshadowed in *Bettongia,* as stated by Bensley, reach a development in *Aepyprymnus* quite bizarre, and which have scarcely been brought out by existing accounts. The first incisor, though not so disproportionately large in its exalveolar portion as in *Potorous,* makes some approach to the persistent pulp condition characteristic of rodent activities, in being excessively long-rooted and in retaining even in very old skulls a wide open apical foramen. In striking contrast to the same tooth in the *Macropodinae* also, it attains its maximum development late in life. The broadening from side to side of the second incisors is so great, that in young animals before the teeth are worn, they fall short of contact in the midline of the palate by less than 1 mm. (fig. 4 D). The transverse diameter of the third incisor is also greatly increased from what obtains in any of the Bettongs and, in addition, its cutting edge is rotated inwards so that it makes an angle of 60° with the long axis of the palate. The deciduous premolar (MP^4) is less molariform than in either *Bettongia* or *Potorous,* and is partially specialized as a secator by the elongation of the antero-external cusp into a longitudinal blade, the edge of which is practically continuous with that of P^3 (see fig. 4, d and e). The effective cutting edge of this combination is equal to, or slightly exceeds, that of the P^4 which replaces it.

Flesh dimensions of an adult male and a subadult female (P^4M^3), both from Thangool, follow:—Head and body, 383, 387; tail, 355, 388; manus, 28, 28; nail of third finger, 17·5, 20; pes, 141, 136; fourth toe, 62, 60; nail of fourth toe, 24, 22; ear, 55 × 30, 52 × 29; rhinarium to eye, 41, 42; eye to ear, 35, 36; weight, 5½ lbs., 7 lbs.

Mean values of the skull dimensions of five adult males, and an adult female, are:—Greatest length, 84, 83; basal length, 73·5, 72; zygomatic breadth, 51, 50; nasals, length, 28, 29·5; nasals, greatest breadth, 17, 19; nasals, least breadth, 10, 10·5; nasals, overhang, 8·5, 9; depth of muzzle, 16·5, 17; constriction, 16·5, 17; palate length, 48, 46; palate, breadth inside M^2, 18, 17; anterior palatine foramina, 3, 3·5; diastema, 10, 10·5; basi-cranial axis, 24, 23·5; basi-facial axis, 51·5, 50·5; facial index, 214, 215.

Maximum dimensions of teeth in the whole series of 14 individuals are:— M^{s1-3}, 18·5, P^3, 7, P^4, 9·5; I^1, 3 × 9; I^2, 3·5 × 4; I^3, 4·5[16] × 4·5.

Of the remaining *Potoroinae, Bettongia penicillata* was taken by Lumholtz on Coomooboolaroo, but has now apparently quite disappeared from there, and is not known elsewhere in the valley, and *Potorous tridactylus,* though it may occur in the wetter coastal scrubs, was not taken.

DESCRIPTION OF PLATES.

Plate I.

Figs. 1 and 2. *Petrogale penicillata herberti.* Showing characters of head. Males from Mount Hedlow.

Plate II.

M. (wallabia) parryi. Showing characters of head. Adult male from Drumburl.

Plate III.

M. (wallabia) parryi. Same individual.

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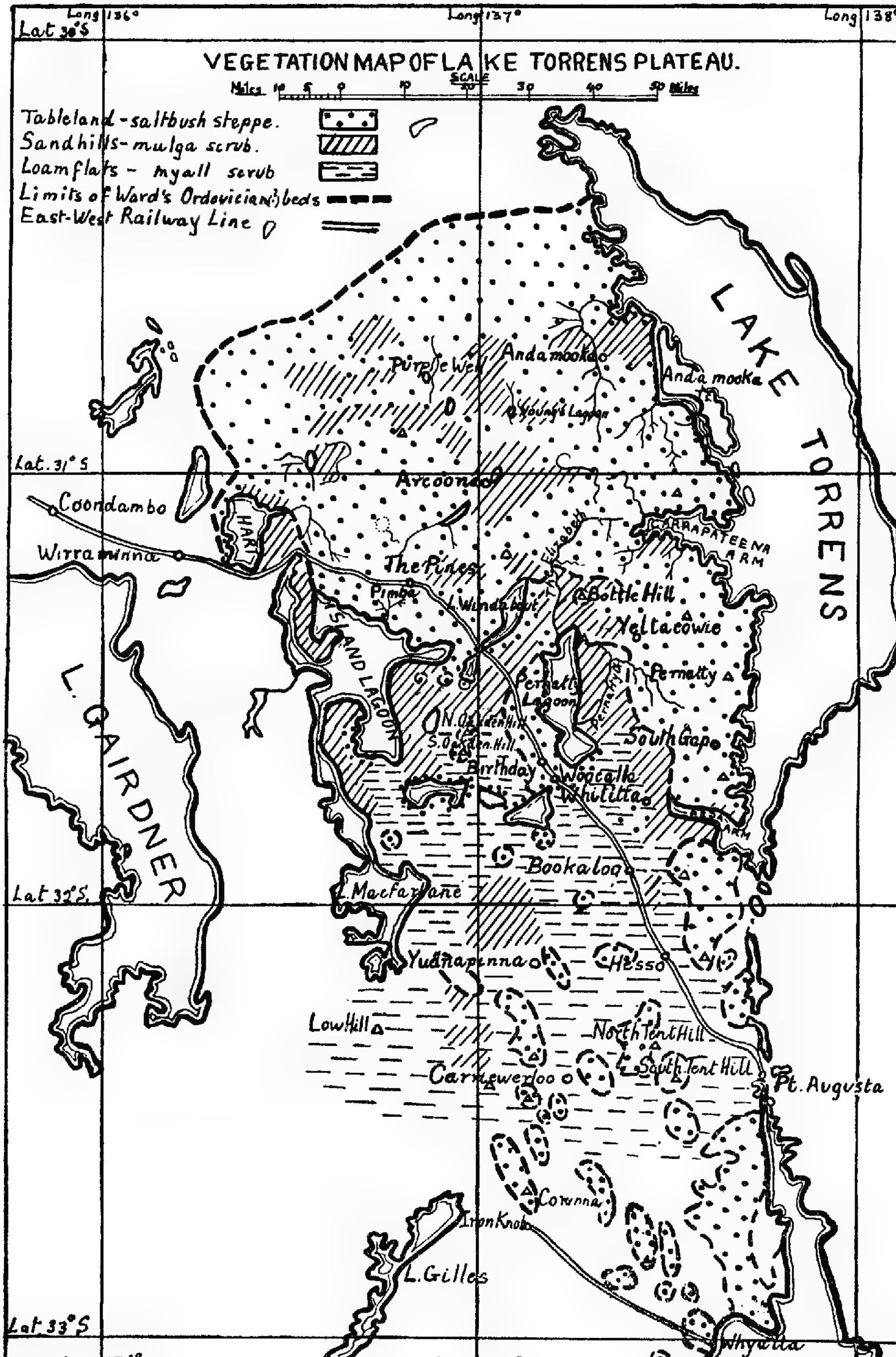
(15) Waterhouse's statement ("Nat. Hist. of Mammalia") that the last tooth of the Potoroinae to come into place is the permanent premolar must be based on a case of delayed succession.

(16) First value is length of cutting edge, not the antero-posterior length as in more normal incisors.


VEGETATION MAP OF LAKE TORRENS PLATEAU.
SCALE
Miles 10 5 0 10 20 30 40 50 Miles
Tableland - saltbush steppe.
Sandhills - mulga scrub.
Loamflats - myall scrub
Limits of Ward's Ordovician(?) beds
East-West Railway Line
Long 136°
Long 137°
Long 138°
Lat 30°S
Lat. 31° S
Lat 32°S.
Lat 33°S
LAKE TORRENS
L. GAIRDNER
Andamooka
Purple Well
Young's Lagoon
Arcoona
Coondambo
Wirraminna
HART
The Pines
Pimba
L. Windabout
Bottle Hill
Yeltacowie
Pernatty
Pernatty Lagoon
ISLAND LAGOON
N. Ogden Hill
S. Ogden Hill
Birthday
Woocalla
Whittata
South Gap
Bookaloo
L. Macfarlane
Yudnapinna
Hesso
Low Hill
North Tent Hill
South Tent Hill
Carriewerloo
Pt. Augusta
Corunna
Iron Knob
L. Gilles
Whyalla

A STUDY OF THE VEGETATION OF THE LAKE TORRENS PLATEAU, SOUTH AUSTRALIA.

By B. Jean Murray, B.Sc.
(Communicated by J. G. Wood, M.Sc.)

[Read August 13, 1931.]

Plate IV.

Contents.

I. INTRODUCTION.

The Lake Torrens plateau and surrounding country is an interesting region to a botanist, as it has not been studied ecologically before, although plant collections were made by some of the early exploring expeditions, notably those led by Babbage and Stuart. Accounts of these expeditions and pioneers of the North-West are given by Threadgill (23) and Richardson (21). The botanical collections made by Hergolt, of the Babbage Expedition, in 1858-9, were named by von Müeller (19). In more recent years Cannon (3) made a brief ecological study of the vegetation round Port Augusta and Tarcoola; Adamson and Osborn (1) described the vegetation at Ooldea, a station on the East-West Transcontinental line, 427 miles west of Port Augusta; and Cleland (4) gives an account of a journey through part of the Lake Torrens plateau and farther North-west to Mount Eba and Tarcoola; it contains plant lists and a brief description of some of the flora, including that on Andamooka.

The present paper is based on observations and collections made from 1927 to 1930, during which time all the stations between Carriewerloo and Arcoona (as far north as Young's Lagoon) were visited and the vegetation studied in different seasons. The country consists of pastoral districts mostly devoted to sheep, although, until recently, cattle predominated on the northern stations on the plateau.

The Lake Torrens plateau lies on the stable foreland to the west of the Lake Torrens faults and consists of Ordovician (?) or, possibly, older rocks which have been eroded to form flat-topped hills and stony or "gibber" tablelands; the altitude is from 500-1,000 feet above sea-level. It is surrounded by Recent to Pleistocene country (less than 500 feet) consisting mostly of loamy flats intersected by sand-ridges, salt-water lakes and lagoons and fresh-water swamps. The whole area lies between the 5- and 8-inch rainfall isohyets and is part of Tate's Eremian Region (22).

Descriptions of the topography and geology of this district are given by Fenner (6, 7), Howchin (12, 13, 14), Gregory (10), and Jack (17). Ward (24) gives the composition of the beds of the plateau as, "dolomitic limestone; quartzite with shaly bands; greenish shale weathering brown; massive siliceous

conglomerate. No fossils known"; and that of the sedimentary beds surrounding it as, "Unconsolidated sand of coast and interior; consolidated sand dunes; saline, gypseous and calcareous earths; travertine limestone; river, lake and swamp deposits; lateritic ironstone; vegetable earths; gravels of outwash fans."

The eastern boundary of the plateau is Lake Torrens, which Madigan (18) has proved to be quite dry, with patches of glistening white salt. After heavy rains it may hold a little water, in places, but this is soon evaporated.

II. CLIMATIC FACTORS.

This region is situated within the typical flask-shaped arid belt determined by the trade winds, and converges towards the southern with the southern boundary of this arid belt (11). The country dealt with in this paper lies between the 5- and 8-inch isohyets to the north and south, respectively. The rainfall over this area is uncertain and influenced both by monsoonal summer rains and winter rains of Antarctic origin; there are no regular wet and dry seasons, and rain is almost as likely to fall in one month as in another; there is perhaps (particularly towards the southern end of the region) a slight preponderance of winter rains with June as the wettest month, whereas in Central Australia it seldom rains during the winter.

TABLE I.

MEAN MONTHLY RAINFALL IN POINTS (100 = 1 INCH).

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Purple Downs	25	47	56	45	35	89	95	42	41	76	37	68	54	685
Arcoona	39	55	51	38	41	79	88	39	33	61	38	46	38	607
Oakden Hills	46	49	45	35	58	74	92	49	56	68	55	64	47	692
South Gap	46	47	50	42	52	85	86	48	54	59	46	57	50	676
Whittita	45	51	48	43	58	84	99	57	63	66	48	50	50	717
Farina	50	53	53	68	42	67	90	37	42	47	48	48	58	653
Port Augusta	69	54	50	72	77	114	117	71	87	95	85	69	59	950

[Figures kindly supplied by Mr. E. Bromley, Government Meteorologist. Yearly records up to 1917 are given by Hunt (16).]

The average rainfall on most of the sheep stations visited is from 6·5 to 7 inches per annum; this is to some extent misleading, for should the country be assured of its average annual rainfall it would be in a much better condition, but good seasons alternate with periods of severe drought when the rainfall may drop to less than 2 inches in a year, to be succeeded by years of greater rainfall until a climax is reached. These very wet years restore the ravages of drought, fill the dams, wells, and waterholes. Thus the reliability of rainfall is poor throughout the area which lies between the isopleths showing 20% to 30% variation from the average amount of rainfall and verging towards 40% variation at the north end of the plateau. Another feature of the rainfall is the manner in which it falls; in some instances the whole year's rainfall may fall within a few days, while in others it may be scattered through several months in a number of ineffectual falls (3).

TABLE II.

DISTRIBUTION OF ANNUAL RAINFALL.

	Arcoona.	Oakden. Hills.	South Gap.	Whittita.
Highest number of wet days per annum	26	43	38	41
Lowest ,, ,, ,, ,, ,, ,,	9	16	16	13
Mean ,, ,, ,, ,, ,, ,,	17	30	24	31
Number of Years in Mean	20	34	34	32
Mean annual rainfall (in points)	607	692	676	717
Highest annual rainfall (in points)	1392	1403	1368	1845
Lowest ,, ,, ,, ...	138	182	168	173

(Figures for the first four items only available up to 1915; last three up to 1928.)

No reliable figures for the temperatures are available. The area lies between the 65° and 70° isotherms, and the nearest meteorological stations are at Port Augusta and Farina which have annual mean maximum and minimum temperatures of 77·2° and 55·3° Fahr., and 80·6° and 54·2° Fahr., respectively. Isotherms showing mean monthly temperatures throughout this region are given by Hunt (15). February is the hottest month. Even in summer there are considerable extremes of temperature, the intense heat of the day being rapidly lost at night by radiation, which is very great in such exposed regions; while in winter the extremes of heat and cold are still greater, and ground frosts fairly common on clear nights during one to four months of the year. Owing to the high temperatures throughout the year, the dryness of the air, and the prevalence of drying winds, the rate of evaporation is very great, this area lying between the 60″ and 80″ isatmics. Managers of some of the stations visited estimate the evaporation of the big dams and waterholes as at the rate of 12 feet per annum; and Howchin (13) gives 100 inches per annum for the amount of evaporation in the arid country round Lake Eyre.

Where the variation in temperature is negligible the main characteristics of the vegetation of a region are determined chiefly by the amount of rainfall and its reliability. By these Tate determined the outlines of his Eremian or arid region; and Wood (26) gives the 8-inch isohyet as the lowest margin for the occurrence of mallee in South Australia. In the Lake Torrens District mallee is a climatic indicator only found towards the south-western boundaries of the southern stations, such as Carriewerloo and Yudnapinna, through which the 8-inch isohyet passes. Between the 8- and 5-inch isohyets no mallee occurs, and the vegetation, which is of the arid type, is fairly uniform in character, differences in the associations being due mainly to edaphic and not to climatic conditions. Perhaps the reliability of the rainfall has more effect in determining the constitution of the vegetation than the actual amount; a region with an average rainfall of 6-8 inches of normal reliability could support a much less arid vegetation than one where, as in the case of this district, the reliability varies up to 40% from the normal, and wet seasons are widely separated by long dry seasons, tending to increase the xerophytic character of the flora.

The vegetation, particularly the therophytic or annual, is noticeably affected by the season in which rain falls. The wealth of herbage produced by winter and spring rains differing largely in constitution (being chiefly composed of Cruciferae, Leguminosae, Zygophyllaceae and Compositae) from that (mainly grasses) growing after summer rains. Certain plants will only develop or flower if rain falls at the particular seasons favourable to them, *e.g.*, the parakeelya and *Crinum pedunculatum*.

III. EDAPHIC FACTORS.

(A) Habitats.

There are three main types of habitat in the district:—

1. The gibber tableland; also characteristic of the tops and sides of the flat-topped hills.
2. The red sandhills.
3. The loamy or sandy flats and claypans between the sandhills and surrounding the plateau.

The gibber tableland comprises most of the plateau and corresponds in extent and boundaries very closely with the area marked "Ordovician" (?) by Ward (24). The gibbers are reddish-brown in colour, of all shapes and sizes, but usually flat and angular, about four inches across by a half to one inch thick; with age and weathering they tend to become rounded and smooth; in some parts younger

Eyrian gibbers may be found (17). The mantle of gibbers acts as a natural mulch; beneath them the soil is red, argillaceous or loamy and of considerable depth (some feet). It collects, without gibbers, in depressions to form "crab-holes" or small swamps.

The sandhills on the plateau may be from 30-40 feet high or less and usually lie at right angles to the prevailing winds, generally in a north-easterly to south-westerly direction; they consist of fine to coarse siliceous particles, red in colour. They are separated by loamy or sandy flats or claypans of varying size. The latter have a retentive floor and may hold fresh or salt water for a short time after rain; some are more extensive and form "playa"-lakes or salinas.

The district surrounding the plateau on the south and extending to and around the numerous lakes and lagoons around the Island Lagoon, which marks the western boundary of these investigations, consists chiefly of undulating country or flats of light red sandy loam or red sandy soil, between red sandhills, or with patches of scattered sand-ridges. Both these sandhills and flats resemble those to be found in certain localities on the tableland (see map), but they are usually of greater extent and the soil on the flats is usually deeper.

There are no permanent water-courses throughout the district, which is outside the great artesian water system (17); but some of the larger gum-creeks, such as the Elizabeth, Pernatty, and Whittita Creeks, may hold water for a considerable time after heavy rains. The tableland and numerous hills and bluffs are drained by smaller stony acacia creeks, which only flow after rain but do not retain water for long.

B. Soils.

The soils of the Lake Torrens plateau and environs have not been properly investigated yet, but appear to be the typical red soils developed under insufficient moisture conditions characteristic of similar dry regions in sub-tropical latitudes and warmer regions of the temperate zone in other parts of the world, *i.e.*, South Africa, Spain, and the dry steppes of Russia and round the Caspian Sea (8). As Glinka (8, 9) pointed out, whatever the origin of the rocks subjected to similar climatic conditions the soils eventually produced from them will be very similar, and this is the case in this region.

The water-retaining capacity of the various soils in this region is considerably less than that given by Wood (26) for typical saltbush, bluebush, and mallee soils outside the 8-inch isohyet. The amount of water at saturation in typical soils from Oakden Hills Station is given below:—

Table III.

Water at Saturation.

Locality.	Amount of Water.
Tableland (saltbush soil)	24·0%
Gypsum (growing saltbush)	30·5%
Limestone knoll (myall and bluebush)	22·0%
Loam flat (myall and bluebush soil)	19·0%
Claypan	22·5%
Claypan, Pernatty Station	22·5%
Dry swamp (lignum)	18·5%
Sandhill (mulga soil)	16·5%

Because of the small amount of moisture the vegetation is not well developed, and consequently there is little humus in the soil, which is always alkaline. The author is indebted to Professor Prescott and his staff at the Waite Institute for the analyses of the soil samples given in the following table:—

Table IV.

Analyses of Soils.

	pH. Value.	Total Salts.	Na Cl.
Tableland—Saltbush and samphire.			
1. Woocalla: *(a)* Gibbers over dark red clayey soil ..	7·9	0·59	0·27
(b) Ironstone gibbers, red clayey soil ..	8·6	0·18	0·01
2. Top of South Oakden Hill, samphire and saltbush, gibbers over red clayey soil	7·7	1·23	0·97
3. Pernatty, gibber plain, no vegetation, polished gibbers over red sand to depth of 4 cm., then clay	7·8	1·13	0·88
Loamy flat, Whittita—Saltbush, mostly dead. Profile taken from sides of dry sandy creek, washed out in loam flat.			
(a) Coarse red sand over light bright-red sandy soil, 3 cm.	8·1	0·06	0·01
(b) Dull, darker reddish-brown soil, fine particles, 20-29 cm.	8·5	0·03	trace
(c) Subsoil, dark bright-red, hard, some scattered stones of various sizes up to 4 cm. long; patches of white throughout, over 40 cm. ..	7·8	1·41	1·25
(d) Below, damp dark red soil	8·2	1·19	0·97
Loam flat, Yudnapinna—*Eremophila glabra*, saltbush and bluebush *(Kochia sedifolia)*.			
Sandy loam, coarse sand over fine particles, 13 cm.	8·3	0·07	0·01
Loam flat, Oakden Hills—Myall and bluebush *(K. sedifolia* and *K. pyramidata)*	9·0	0·10	0·02
Toby's Swamp, Pernatty — Canegrass flat *(Glyceria ramigera)*.			
Red sand to depth of 4-6 cm.; black soil below ..	8·4	0·12	0·01
Edge of swamp, Pernatty—Gums *(Eucalyptus rostrata)*.			
(a) Whitish sand	8·5	0·03	trace
(b) Hard greenish-white patch in sand, no vegetation	8·3	0·07	0·02
Claypan, Pernatty—No vegetation.			
Hard light red clay	7·9	0·35	0·20
Swamp, Oakden Hills—Canegrass, samphire and typical mixed swamp flora.			
Clay, brown and cracked on surface, 1-2 cm.; red clay below, 4-6 cm.	8·3	0·45	0·09
Lake Torrens, South Gap.			
1. Sample taken on lake, 100 yards from shore.			
(a) To 24 cm.	Large amount of gypsum		
(b) Below 24 cm.	8·6	high	5·30
2. Sample taken on shore two yards from edge of lake — Samphire *(Arthrocnemum halicnemoides* var. *pergranulatum)*.			
Sand	8·0	1·00	0·63
3. Sample taken on shore, 60 yards from edge of lake—Samphire, saltbush and bluebush *(K. tomentosa* var. *appressa)*.			
Sandy soil	8·2	0·05	0·01
The following was obtained and analysed later by the author:—			
Sandhills, Oakden Hills—Mulga.			
Bright red sand for a considerable depth		0·50	0·03

It will be seen that the alkalinity of the soils is high; and in many cases the percentage of total salts is high also, possibly owing to the frequent occurrence of gypsum throughout the district as well as the large amount of sodium chloride present in many soils, accounting for the halophytic character of the vegetation, *i.e.*, the general occurrence of samphire on the tableland; the saltbush *(Atriplex vesicarium)* is also more tolerant of salt than the bluebush *(K. sedifolia)*, which usually only occurs in crab-holes or towards the edge of the tableland.

IV. ANALYSIS OF THE FLORA OF THE REGION—FLORISTICS.

(A) Origin and Distribution of Species.

This region is part of Tate's Eremian Region of the Australian Flora (12, 22). In Cretaceous times, when the endemic flora of Australia arose, the Lake Torrens plateau was doubly cut off from the migration of species from the west (25); when the Cretaceous seas receded, the climatic changes of the Tertiary period were already bringing that increasing aridity which has since proved such an effective barrier against invasion from the south-western flora. It, therefore, seems apparent that at least for long periods of time migration from the west into this limited area must have come from the south by way of the narrow coastal belt. On the other hand, eastern communications with this area were never completely severed. The relationships between the percentages of species found also in West and East Australia are almost identical to those quoted by Wood (27) for the Flora of the Gulf Region of South Australia, thus pointing to the same sources of origin. These figures are all the more striking because the individual composition of the floras is very different.

Three hundred and eighty-seven plants are recorded for the Lake Torrens Region. Fifty-six Natural Orders are represented, including 177 genera containing 372 species, of which 17 were only found in a varietal form; in addition there were 15 varieties of species already found there, and 15 were introduced plants.

Table V.

Distribution of Species throughout Australia.

		%	*Gulf Region. %
Total number of species found in Lake Torrens region	387	—	
Number of species found also in Eastern Australia	316	80	84
Number of species found also in Western Australia	172	44·5	46·5
Western Australian species found also in Eastern Australia	156	40	41
Species found in Eastern Australia but not in Western Australia	150	39	40
Species found in Western Australia but not in Eastern Australia	17	4·5	3
Species endemic to South Australia	31	9	13
Species found also in Central Australia	72	18·5	—
Species found also in North and Tropical Australia	32	8	—
Species found throughout Australia, chiefly in warm dry parts of Temperate Australia	80	20·5	-
Cosmopolitan species	5	1	—

*In the last column of this table corresponding figures for the Gulf Region based on Wood's figures (27) are given for comparison.

Although having most in common with the arid flora of the Far North and with that of the adjacent Flinders Range, it will be seen from the following table, based on localities given by Black (2), that most of the species found on the Lake Torrens plateau are widely distributed throughout the drier parts of South Australia.

Table VI.

Distribution of Species throughout South Australia.

	Total.	%.
Total number of species in Lake Torrens region	387	—
Number common with Far North	237	61
Number common with dry northern districts	43	11

	Total.	%.
Number common with Far North-West	99	25
Number common with western region from Port Augusta to Ooldea	132	34
Number common with Flinders Range	170	44
Number common with Murray Lands	154	39·5
Number common with North-East and East	75	19
Number common with Southern region	67	17
Number common throughout the State	39	10
Endemics found only in the Lake Torrens region (including 3 undescribed varieties)	7	2

Only 43 (including 4 varieties) of the 657 species listed by Wood for the Gulf region are found also in the Lake Torrens region; but 170 species (including 8 varietal forms) are shared with the Mallee region which lies between the 8- and 20-inch isohyets, and for which Wood (26) gives a total of 590 species. Out of 188 species given by Adamson and Osborn (1) for Ooldea, on the Nullarbor Plain, 95 are shared with the Lake Torrens region, which has a similar climate.

(B) Endemics, Restricted and Compound Species.

The following endemics are found only in the Lake Torrens district:—*Swainsona Burkittii, S. adenophylla, Phyllanthus rhytidospermus;* also a new genus of Borraginaceae *(Embadium stagnense* J. M. Black), a weeping variety of *Acacia Sowdenii,* which itself only occurs from Port Augusta to Ooldea, a succulent variety of *Euphorbia eremophila* and, possibly, a new species of *Bassia.*

Other South Australian endemics of very limited distribution recorded for this district are:—*Thysanotus exiliflorus, Amarantus Mitchellii.* var. *grandiflorus; Hakea cycloptera* (19), *Thryptomene Elliottii, Minuria annua, Anacampseros australiana,* and *Dimorphocoma minutula.* The last two are monotypic genera. While other species, not endemics, of limited distribution in the State found in this district are:—*Cyperus enervis, Heleocharis multicaulis, Eucarya spicata, Trichinium erubescens* (4), *Sisymbrium erysimoides, Lepidium pseudo-ruderale, Acacia Burkittii, Zygophyllum prismatothecum, Hermannia Gilesii, Verbena supina, Eremophila Paisleyi, Trichodesma zelanicum,* var. *latisepalum; Helichrysum Cassinianum,* and *Calocephalus Sonderi* (19).

The number of species is high in certain dominant genera *(e.g., Atriplex* has 17 species and varieties, *Bassia* 16, *Kochia* 15, *Eremophila* 13, *Acacia* 11, *Zygophyllum,* and *Helipterum* 9), while normally the rate is low, even including varieties as distinct for purposes of comparison (2·2 species per genus). Many of the more successful species are in a great state of variability; 17 species were found in varietal forms only, while 15 varieties of species also present were found. The genera *Eragrostis, Swainsona, Sida,* and *Brachycome,* and the species *Atriplex vesicarium, Acacia aneura, A. Sowdenii, Cassia Sturtii,* and *Euphorbia eremophila* being particularly noticeable in this respect. No doubt these are all compound species or linneons, and in some cases several distinct jordanons have been described; the numerous forms noticed in *Atriplex vesicarium, Kochia tomentosa, Acacia aneura,* and *Cassia Sturtii* need investigating to show whether they are jordanons, hybrids or epharmones, but as they are usually found growing more or less together in similar habitats, it is most likely that they are hybrids between two or more jordanons.

Atriplex vesicarium, the common saltbush, is a particularly variable plant, and much research is needed to separate the various strains; pastoralists recognise them when they point out various kinds as more or less palatable to sheep—all of which would be classified without hesitation by a systematist as *A. vesicarium.*

The chief distinction appears to be in the size of the leaves, and in some measure in the size of the bladder or appendage on the fruits which gives the plant its name of "bladder saltbush." The most common kind found on the tableland, and the one most liked by sheep, has very small leaves and large spongy bladders on the fruiting bracteoles. Sheep apparently do not care much for the type with larger leaves which usually has much smaller or often no appendages on the fruits; this form approaches to *A. paludosum*, which also has a form (var. *appendiculatum*) that often has a small appendage on the fruiting bracteoles and is a form connecting this species with *A. vesicarium* (2). The two forms are evidently closely related, *A. paludosum* and the forms, possibly hybrids, of *A. vesicarium* most closely approaching it being unpalatable to sheep, which are partial to the more typical *A. vesicarium* forms. *A. paludosum* was not found by the author, although recorded for Beda near Lake Torrens (19).

Crotalaria dissitiflora exhibits an epharmonic desert form, only producing its three leaflets in damp localities or after an exceptionally rainy season. *Cassia eremophila*, var. *platypoda*, may also be an epharmone, while a new succulent, normally leafless form of *Euphorbia eremophila* is being studied to see whether it be merely the tableland epharmone, a true jordanic variety, or distinct species. *Anguillaria dioica*, found on the tableland at Yeltacowie, had typical pinkish-white flowers, while those found about 30 miles away, on a sandy bluebush flat at Arcoona, had greenish-yellow flowers with a brown gland, and the plants were much larger; the two types were never found growing together.

V. ANALYSIS OF THE VEGETATION OF THE REGION—ECOLOGICAL.

(A) Life-forms.

In Table 8 is given the biological spectrum of the vegetation of the whole Lake Torrens region, together with those of the vegetational units found on the various habitats. For comparison the "Normal or World Spectrum" is shown, also that for the somewhat similar arid region at Ooldea, and that for the Mallee region which lies outside the 8-inch isohyet and forms the southern boundary of the Lake Torrens region. There are no other spectra of the vegetation of arid regions in South Australia available at present.

Table 7.

Spectrum of Lake Torrens Region.

	No. of Species.	M.M.	M.	N.	Ch.	H.	G.	Th.	E.	S.
Normal	400	6	17	20	9	27	3	13	3	1
Mallee (26)	600	—	13	30	19	11	3·5	21	—	—
Ooldea (1)	188	0·5	19	23	14	4	0·5	35	4	—
Lake Torrens region ..	387	1	10	24	17·5	11	1·5	32	2	0·5
Gibber tableland ..	156	1	14	25·5	13	8·5	0·5	33·5	2·5	1
Sandhills	106	—	18	24·5	9	12	1	31	3·5	—
Loam or sandy flats ..	121	—	17	20·5	11·5	14·5	1·5	31	3	—
Claypans	33	6	12	30	15	6	3	27	—	—
Fresh-water swamps ..	155	1	·4	19·5	18	15	—	42·5	—	—
Salt-water swamps ..	13	—	7·5	69	15	—	—	7·5	—	—

The most noticeable feature of the spectrum of the whole Lake Torrens district, also of its constituent plants, as compared with the normal, is the very high percentage of low, woody plants, chaemophytes and smaller nanophanaerophytes, and of the ephemeral plants or therophytes, while the hemicryptophytic percentage (mainly represented by grasses) is very much lower. It will be seen from a comparison of their spectra, that this region is more or less intermediate between Ooldea and the Mallee.

(B) Main Associations.

In this district are to be found three distinct types of vegetation to be correlated with the three main habitats already described, *i.e.*:—

(a) Saltbush steppe on the gibber tableland and flat-topped hills.
(b) Mulga scrub on the sandhills.
(c) Myall scrub on the loam flats between the sandhills on the plateau and covering larger areas beyond its limits.

In addition there are distinct associations on the claypans, round fresh-water swamps and dams, and round salt-marshes, lakes and lagoons. These are somewhat similar to those described for arid New South Wales by Collins (5).

(1) Vegetation of the Tableland.

(a) Saltbush Association.

About two-thirds of the whole Lake Torrens plateau consists of undulating, stony country coated with gibbers and known locally as "the tableland." The stations of Arcoona, Yeltacowie, and South Gap consist very largely of this tableland country. It is characterised by a low, grey, scrubby vegetation, which stretches for miles in a wide unbroken expanse; for, except along the watercourses and in depressions of the small crab-hole type or larger "dongas," there is a complete absence of trees or shrubs of any size.

The dominant plant on the gibber tableland is the "bladder saltbush," *Atriplex vesicarium.* This is the main fodder plant or stand-by of the semi-arid country, and can withstand very dry conditions owing to its mealy grey leaves, the swollen epidermal cells of which are a protection against excessive sunshine and evaporation, and also absorb the heavy dews of this semi-arid region during the long intervals between rains. The gibber covering of the tableland also serves as a sort of natural mulch, shading the soil and protecting it from drying out, and conserving the dews for the use of the surface roots of the saltbush and other xerophytic plants which are able to withstand excessive insolation and dry conditions.

The saltbush may exist in almost pure association, forming a stable climax community of the open type for most of the year but mixed with a therophytic flora after the rainy season. On the other hand, it may be associated with other xerophytic plants of the same type, *i.e.*, "tomentose microphylls," chiefly species of bluebush such as *Kochia sedifolia, K. pyramidata, K. aphylla, K. Georgei, K. tomentosa, K. spongiocarpa, K. ciliata, K. eriantha, K. excavata,* var. *trichopoda;* "bindyi," including *Bassia ventricosa, B. intricata, B. obliquicuspis, B. divaricata, B. paradoxa,* and *B. pachyptera; Frankenia serpillifolia,* and composites such as *Ixiolaena leptolepis, Minuria Cunninghamii,* and *M. denticulata.* Other common plants in this association are the samphires *(Arthrocnemum leiostachyum* and *Pachycornia tenuis),* pigface *(Mesembryanthemum aequilaterale), Trichinium obovatum, Swainsona stipularis* ("Vetch"), and *Abutilon halophilum.* Various tuft grasses occur among the saltbush in many places, Mitchell grass *(Astrebla pectinata)* being the most important. This is fairly common on the tableland, especially towards the northern end, but towards the southern end it appears to occur in localized patches; it is a valuable fodder found throughout the Far North and Far North-West, but is probably confined to the drier regions and limited by the 7-inch isohyet.

The therophytic part of this association is dependent upon the season when rain falls. After winter rains the "annual saltbush" *(A. spongiosum* and *A. halimoides), Blennodia narsturtioides* and other Cruciferae, *Zygophyllym ammophilum* and *Z. prismatothecum* are among the first to appear; then numerous composites

such as *Brachycome pachyptera, Senecio Gregorii, Helipterum polygalifolium, H. corymbiflorum,* and ephemerals like *Dimorphocoma minutula, Minnuria annua,* and *Helipterum pygmaeum; Erodium cygnorum, E. cicutarium, Daucus glochidiatus,* and the "poison-weed" *(Lotus australis,* var. *parviflorus)* also occur; then various grasses make their appearance. These are more abundant after summer rains, when numerous succulent plants also occur, such as "munyeroo" *(Portulacca oleracea)* and the rather rare "kunyami" *(Anacampseros australiana),* both splendid fodder plants; the latter was found on South Gap, near Lake Torrens. *Trichinium nobile* is not uncommon, and *Euphorbia Drummondii,* known locally as the "belladonna plant," is fairly abundant and considered poisonous to stock. A curious plant found on the tableland on South Gap, Yeltacowie, and on the top of South Oakden Hills was a leafless, brownish succulent-stemmed form of *Euphorbia eremophila,* the typical form of which was only found in creek beds on the tableland, though it was common on the sandhills and round swampy places. *Zygophyllum fruticulosum* and *Gumniopsis quadrifida* ("star-bush") frequent poor country where there is an abundance of gypsum, as around Pernatty Lagoon.

The most interesting feature of the saltbush association on the tableland is the frequent occurrence of samphire (chiefly *Arthrocnemum leiostachyum* and *Pachycornia tenuis)* among the saltbush (pl. iv., fig. 1). In other arid and semi-arid regions of South Australia samphire is confined to areas round swamps and marshes, chiefly of a salty nature. Here it occurs exposed on the open tableland far from any swamp or lagoon, though it is frequent, with other species, round both fresh- and salt-water swamps and lagoons; it is also prominent on top of dry, stony, flat-topped hills such as South Oakden Hill, and is particularly abundant in places where drought or over-stocking has deplenished the saltbush. It will be clear from Table 4 that the soils of much of the tableland and flat-topped hills have a very high percentage of total salts and sodium chloride, which evidently accounts for the presence of these very halophytic plants away from their usual habitat, and also points to the high tolerance of salts in the saltbush. It is probably for this reason that the bluebush *(Kochia sedifolia),* although considered more xerophytic than saltbush (1), does not occur frequently on the main tableland. Moreover, the tableland, with its mantle of gibbers acting as a mulch to protect the soil, is really a less xerophytic habitat than the porous, unprotected soil of the open Nullarbor Plain where the bluebush is dominant; and so it favours the establishment of the dominant salt-tolerant saltbush, except in cases where the natural balance of the vegetation has been upset or where local edaphic conditions favour the bluebush.

(b) Succession and Regeneration.

The climax association of the gibber tableland as indicated by the saltbush is of a stable nature, and under natural conditions is able to withstand severe drought conditions; while it may actually benefit from the effects of controlled grazing, continuous grazing over long periods disturbs the proportion of the saltbush and paves the way for subdominant species such as samphire, bluebush, and bindyi. The occurrence of a drought aggravates these conditions, and as samphire is even more xerophytic than saltbush the latter is to some extent choked out. Another danger of over-stocking is that not only is the established saltbush eaten out, trampled down and prevented from fruiting, but the intense insolation and great radiation of heat from the exposed gibbers hinders the growth of seedlings which would normally thrive in the meagre shade of the saltbush and other low shrubby plants, and those that do survive are immediately eaten off, so that the natural process of regeneration is cut off at its source. On the gibber tableland there is not the same danger of drifting sand and the deterioration of "eaten-out"

country by wind erosion that there is on the loam and sandy flats and sandhills; but it will soon revert to bare, dry, useless, stony plains unless set aside for a number of years for natural regeneration to take place—that is provided the process of depletion has not been carried too far first.

The first colonizers of a bare, eaten-out gibber paddock are species of bindyi, annual saltbush, chiefly "pop saltbush" *(A. spongiosum* and *A. halimoides)*, mixed with other annuals, according to the season; then comes the samphire; while pigface and *Frankenia serpillifolia* occur locally.

The next phase may be occupation by bluebush, but owing probably to the high percentage of salt in many places this is not of general occurrence, and usually appears towards the margins of the tableland, where it merges into sandhills, or where it passes into loamy or sandy flats, *e.g.*, near the edge of the tableland near Arcoona homestead, where most of the species of *Kochia* occur where the saltbush has been eaten away. *K. sedifolia* and *K. pyramidata* are also common amongst, or taking the place of, saltbush towards the southern end of the plateau where the country is bare and eaten out and the gibbers sparse and scattered between Port Augusta and Carriewerloo and the east end of Yudnapinna. Probably the soil is less salty here and thus favours bluebush rather than samphire, while the absence of a gibber mulch would make conditions more xerophytic, so that bluebush rather than saltbush could survive best after drought. This is rather like the saltbush association on the rubble flats described by Collins (5). Saltbush is undoubtedly the dominant plant of the climax association on the tableland and, if left alone, will eventually re-establish itself.

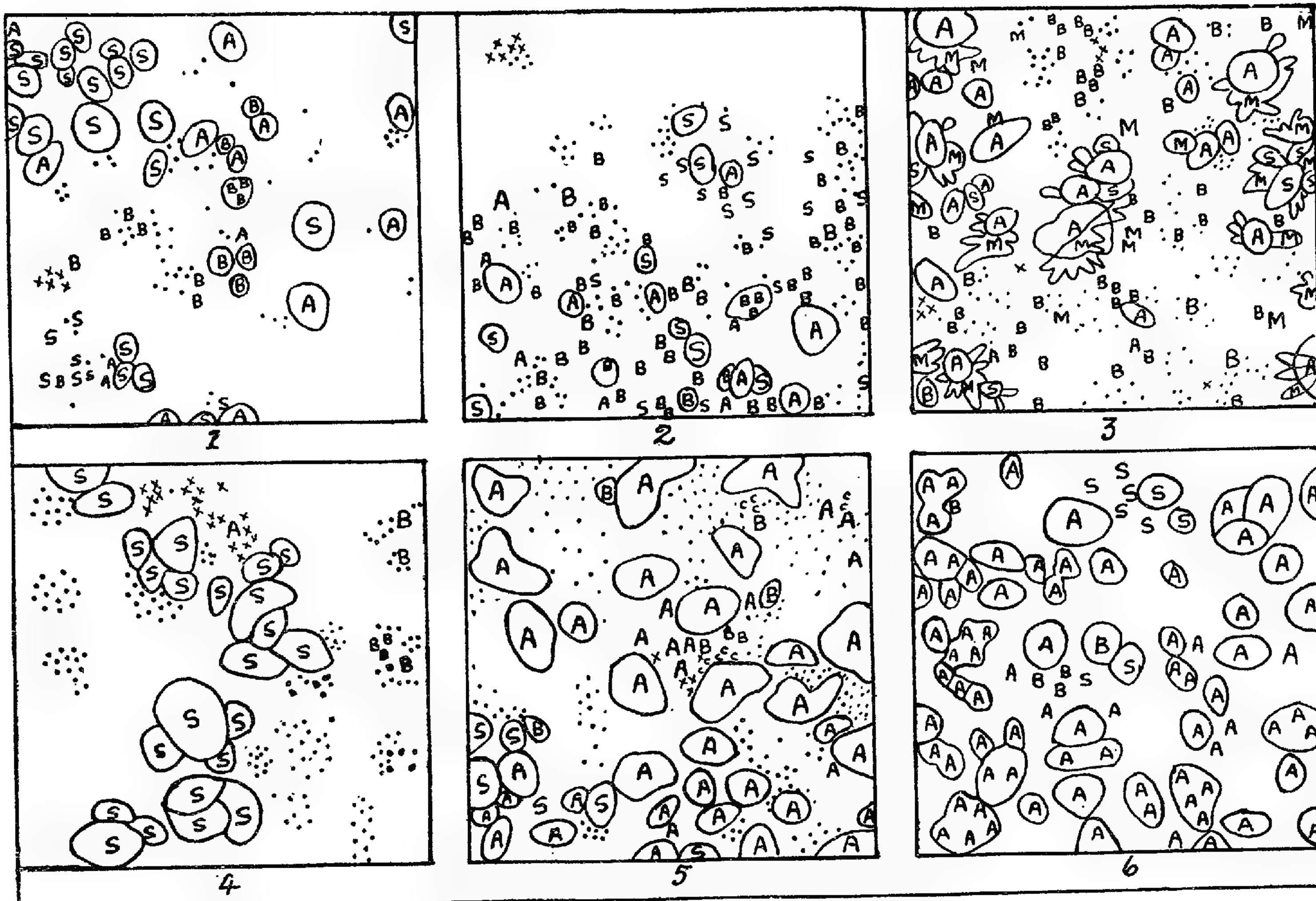
Where the typical saltbush association occurs on loamy or sandy flats on the plateau or outside its limits, as near Whittita or on the more southern stations, it is probably a sub-climax or sere in the myall or mulga scrub associations, in which it usually forms the lower stratum.

During the winter of 1927 a series of quadrats were plotted in the paddocks round the woolshed at Yeltacowie, to show the effects of drought and overstocking in the saltbush association and the development of the subsere following on its destruction. In July rain fell, after eleven months drought, freshened up the saltbush and induced a crop of seedlings and annuals to spring up later. Shearing took place in the early spring, so that for several months these paddocks had not been used much for grazing. Fig. 1 (Nos. 1-6) shows selected quadrats, each 5 metres square, taken in three adjacent paddocks.

The woolshed paddock was surrounded by gibbers, bare except for a little bindyi, and then samphire; towards the middle of the paddock there was little saltbush left, samphire was frequent, and bindyi seedlings plentiful after the rain. (Nos. 1 and 2 were 150 yards apart on either side of a road through the centre of this paddock.) Some bluebush was found in the middle of this paddock; while towards the *Acacia rigens* creek boundary there was some pigface mixed with an increase of saltbush. (No. 3 was 200 yards from No. 2, and 100 yards from creek.)

No. 4 was taken 100 yards from the other side of this creek and in the second paddock, which was not so depleted as the woolshed paddock, but showed a fairly high percentage of samphire, which was replaced towards the centre and other side by saltbush. (No. 5 was 350 yards from No. 4.) There were numbers of seedlings but no pigface or bluebush.

For comparison No. 6 was plotted in the third paddock, about 500 yards from the fence dividing it from the second paddock. Here the saltbush was typically and uniformly good, mixed with a very little samphire. There were numerous saltbush seedlings, but few other plants or seedlings.



EXPLANATION OF FIGURE (quadrats each 5 m. square).

A = saltbush *(Atriplex vesicarium)*
M = pigface *(Mesembryanthemum aequilaterale)*
S = samphire *(Arthrocnemum leiostachyum)*
. . . . = other seedlings, chiefly bindyi and grasses
B = bindyi *(Bassia* spp.)
xxx = saltbush seedlings
ccc = composite seedlings

(c) Vegetation of the Creeks of the Tableland.

There are a number of other plants occurring only in crab-holes or dongas, along the banks and in beds of creeks on the tableland and down gullies in its rocky sides. Thirty-five per cent. of the species collected on the tableland were either confined to the creek beds, etc., or, if also found on the tableland, were most common in the former localities; this refers very noticeably to the larger shrubs and trees, 71% of which were mainly confined to the creek beds; while 30% of the nanophanaerophytes, chaemophytes hemicryptophytes and theophytes were most common in such places.

The only trees at all frequently found on the open tableland were *Eremophila glabra* ("tar-bush"), *Acacia tetragonophylla* ("dead finish") and *Casuarina lepidophloia* ("black oak"). The latter may occur isolated on the tableland, or more often in societies or clans dependent upon its method of reproduction by adventitious root buds. It is more often found in depressions or up steep sides and gullies, where water relations are slightly better than upon the open tableland; and it also frequently lines the creek beds, either in clans or societies, mixed with various acacias and other shrubs such as "nigger-bush," *Rhagodia spinescens, Prostanthera striatifolia, Eremophila* spp., etc.

On South Gap, Pernatty, and Yeltacowie stations, a feature of the landscape is the number of small creeks outlined by the tableland "myall," *Acacia rigens,* which is quite distinct from the myall of the flats *(A. Sowdenii).* Water only flows in these creeks after heavy rains. The "grey mistletoe" *(Loranthus quandang)* is a common parasite on *A. rigens.* Other shrubs often found along these creeks are:—*A. tetragonophylla, Cassia Sturtii, C. phyllodinea, Heterodendron oleifolium, Exocarpus aphylla, Eremophila glabra* and others, *Kochia aphylla, K. pyramidata* ("nigger-bush"), *Zygophyllum fruticulosum, Abutilon leucopetalum, Sida petrophila, Solanum ellipticum, Dodonaea lobulata, Pittosporum phillyreoides, Muehlenbeckia Cunninghamii,* the "paddy" and "bastard melons" *(Cucumis myriocarpus* and *Citrullus vulgaris),* and many others. Other creeks are dominated by different small trees such as *Acacia Victorieae,* associated with *Santalum lanceolatum, Eucarya acuminata, Eremophila longifolia,* and other shrubs.

The larger creeks, such as the Elizabeth, Pernatty, Whittita, and Yeltacowie creeks are bordered by *Eucalyptus rostrata* ("red gum"), the only common large tree on the plateau, and remarkably drought resistant. After the breaking up of the last long drought, gum trees, which had been apparently dead for six years, revived at South Gap. In good seasons these creeks often retain water in more or less permanent water-holes at many places. In and along the gum creeks are sometimes found *A. rigens* and most of the small shrubs and trees found along the myall creeks, as well as many others such as:—*Acacia Oswaldii, Myoporum montanum, Eremophila Latrobei, Pimelea microcephala* (rare), *Solanum petrophilum, Trichodesma zelanicum, Phyllanthus lacunarius, Euphorbia eremophila* (typical form), *E. Drummondii, Tribulus terrestris, Hermannia Gilesii,* and numerous grasses and therophytes. *Acacia salicina* ("native willow"), supposed to indicate fresh water occurs rarely.

Small depressions in the tableland, where a greater depth of soil accumulates and moisture collects, may harbour a more varied flora than on the main tableland; they vary in size from crab-holes, chiefly populated by annuals and grasses, to small dongas, when such shrubs as *Eremophila glabra, E. Duttonii, E. oppositifolia, Pittosporum phillyreoides, Cassia Sturtii, A. tetragonophylla, K. aphylla, K. pyramidata* may occur in them. These small communities represent a post-climax induced by the slightly better edaphic and climatic conditions in small local areas than pertain on the open tableland, where the climax is reached in the saltbush steppe.

(2) Vegetation of the Sandhills.

This differs markedly from that of the tableland; there is not so great a variety of species, but although no large trees are to be found there is an increase of small trees and shrubs. Micro- and nanopanaerophytes form 42·5% of the flora; 9% are chaemophytes; therophytes (31%) and hemicryptophytes (12%) are only to be found after a rainy season.

(a) Colonization of the Psammosere.

There is a marked transition belt or ecotone between the vegetation of the tableland and that of the sandhills. This may be seen behind the homestead at Yeltacowie, as the margin of the tableland is approached saltbush and samphire are replaced by bluebush *(Kochia sedifolia)*, which is superseded by *K. pyramidata* ("pyramid bluebush" or "nigger-bush") as it becomes more sandy; while on the slopes of the more established sandhills mulga *(Acacia aneura* and *A. brachystachya)* are associated with the bluebush.

Sandhills throughout the district vary from bare drifting sand, through various stages of colonization, to the more or less stabilized dunes covered with the stable but open association of the mulga scrub. Where the sandhills are exposed, bare and unstable, the "rattle-pod" *(Crotalaria dissitiflora)* forms pure colonies of considerable size; colonies are also found among the sparsely scattered mulga, when that is able to establish itself. "Roly-poly" or "buckbush" *(Salsola Kali* and *S. Kali*, var. *strobilifera)* also forms pure colonies on the bare sides or in depressions in the sandhills, and surrounding rattle-pod colonies, mulga *Acacia ligulata* ("umbrella bush") and other shrubs; even the dead buckbushes help to stabilize the sand in a dry season.

Then may follow socies of *A. ligulata*, *Dodonaea attenuata* ("hop"). *Heterodendron oleifolium* ("bullock bush") forms small colonies on drifting sand, and occasionally *Hakea leucoptera* ("needle-bush") is found. *Lycium australe* ("the Australian boxthorn") may also be found as isolated bushes or in small colonies, often at the transition zone between sandhills and tableland or flats; and *Spinifex paradoxus* ("sandhill cane-grass") occurs in similar places. Then the mulga and bluebush become increasingly frequent, and gradually with the aid of smaller shrubs and annuals a more or less stable dune is built up.

Collins (5) described stages in the colonization of sandhills and mulga scrub association on the rocky hills and slopes of the Barrier Region, New South Wales, which have many features in common with the colonization of the sandhills and mulga scrub association developed in this region.

(b) Mulga Scrub Association.

The "Character plant" of the climax association on the sandhills is the mulga (chiefly *A. aneura)*. Besides the shrubs already mentioned others occurring more or less throughout the mulga scrub are:—*Cassia Sturtii*, *C. eremophila*, var. *platypoda*, *Myoporum deserti*, *Eremophila Latrobei*, *E. Duttonii*, and *E. glabra*. *Eucarya Murrayana* ("bitter peach"), *E. spicata* ("commercial sandalwood"), and *Exocarpus aphylla* are usually found growing near a mulga, all being root parasites. The last shrub greatly resembles *Templetonia egena* ("broom bush"), which may also be found on the sandhills.

Another common and interesting shrub is *Pimelea microcephala*, which is usually found in a green, flourishing condition with its main stem leaning against or twisted round some other tree, usually a mulga or umbrella bush; in many cases the supporting trees, though apparently more xerophytic than the *Pimelea*, were dying or dead. Either the latter is extremely hardy and deep-rooted or the possibility of root-parasitism presents itself.

The most common undershrub in the mulga scrub association is the bluebush, chiefly *K. pyramidata,* but also *K. sedifolia* on the more stable slopes, and occasionally *K. aphylla.* Various species of saltbush occur on the well-colonized hills, including *Atriplex vesicarium, A. stipitatum* ("sandhill saltbush" which is not liked by sheep), *A. velutinellum* and *A. limbatum;* also several species of bindyi, including *Bassia ventricosa* and *B. parallelicuspis. Rhagodia Gaudichaudiana, Encylaena tomentosa* ("ruby saltbush") and *Gumniopsis quadrifida* ("starbush") are fairly common, often forming tufts on small hillocks of sand. *Glycine sericea* is often found trailing over rattle-pods, and *Trichodesma zelanicum* occurs round bullock-bush and in "blow-outs."

Although it at first appears that bluebush *(Kochia,* spp.) is dominant in the lower shrubby stratum, it is more probable that this represents a sub-climax, and the true climax is attained when the dune is sufficiently stabilized to permit the establishment of the saltbush, which may frequently be mixed with bluebush or, if undisturbed, gradually displaces it. However, here, as in other habitats, the bluebush appears to be more xerophytic than saltbush and to feel the effects of drought less.

The lowest stratum or ground vegetation of the mulga scrub association is largely dependent on the season in which rain falls, as it consists mainly of annuals (therophytes) and grasses. During June and July, 1927, after a long period of drought, there was little therophytic ground covering among the shrubs and trees on the sandhills at Yeltacowie with the exception of buckbush, annual saltbush and some grasses. Rain fell during July and raised up an appreciable growth of seedlings; but the main annual flora developed by these rains was studied at Arcoona in September. The sandhills on this station are covered with mulga scrub similar to that on Yeltacowie and Pernatty, but are, on the whole, more stable and consolidated. The ground stratum, consisting largely of therophytes, was well developed by September.

Emex australis ("Prickly Jack"), *Goodenia cycloptera* and *Phyllanthus Fuernrohrii* being among the first colonizers of the bare sandy hillsides (psammosere). These formed pure colonies or were associated with each other, and were also frequent on the more consolidated parts under mulga and other shrubs, where they were mixed with a varied flora. Seasonal aspects are very noticeable among these lower stratum societies, the following species dominating in turn:—annual saltbush *(A. velutinellum, A. limbatum, A. spongiosum); Podolepis capillaris* and *Blennodia canescens* ("wild stock"); *Zygophyllum Howittii, Z. tesquorum, Z. ammophilum; Swainsona phacoides* ("wild violet"); *Erodium cygnorum* ("blue geranium"—an excellent fodder plant common with the last species on the flats); composites such as *Calotis cymbycantha, Helipterum floribundum, H. moschatum, Helichrysum semifertile, H. apiculatum, Myriocephalus Stuartii, Craspedia pleiocephala, Senecio brachyglossus,* and occasionally *S. lautis; Sidacorrugata, S. intricata, S. virgata,* and *Abutilon leucopetalum; Stipa nitida, Trisetum pumilum,* and other grasses. Other species commonly occurring are *Tetragonia expansa* ("wild spinach") and *T. eremaea, Trichinium alpecurioideum, Lappula concava, Nicotiana suaevolens, Plantago varia,* and *Goodenia argentea,* though that is more common on the flats, and *G. cycloptera* on the sandy parts. Parakeelya *(Calandrina remota* and *C. volubilis),* a splendid fodder plant on which sheep can thrive for months without water, forms prominent societies round the mulgas in a good season; although not as common as on the sandhills, parakeelya is also found on the flats, particularly round the bases of trees.

In April, 1930, there was little ground covering on the sandhills on South Gap, Pernatty, and Oakden Hills. After a prolonged drought rain fell in the preceding December-January, and was productive chiefly of grasses such as *Aristida arenaria* ("mulga grass"), *Triraphis mollis, Paspalidium jubiflorum,*

P. gracile, Digitaria Brownii, Panicum decompositum, etc. *Trichinium alpecurioïdeum* was also found.

From the mixed mulga scrub described one must distinguish the type with *A. aneura* and *A. Burkittii* ("sandhill mulga" or "needle-bush acacia") dominant. This is common between Yeltacowie and Oakden Hills, along the East-West Railway Line between Bookaloo and Hesso, and on the sand-ridges that intersect the flats just outside the limits of the plateau. Under the spreading *A. Burkittii* there can be little or no undergrowth, but in between the bushes and the other mulgas may be found saltbush or bluebush and the usual annuals in season. *A. Burkittii* may also occur as isolated shrubs in the mixed mulga scrub association.

Quite another type of vegetation is sometimes met with in the sandhill country; mulga scrub on the flats and slopes will graduallly merge into "native pine" forest *(Callitris glauca)*. On the fringe pine and mulga will be mixed, but on the ridges almost pure pine association will occur. Under the pines is little or no undergrowth, except grasses. These pine forests were once much more extensive than they are now, but they have been largely cut down; they may be seen at The Pines on Arcoona, and between Yeltacowie and Pernatty. Occasionally isolated pines or small groups may be found in the mulga scrub association, or more rarely on the flats.

On Arcoona, and elsewhere, one occasionally meets with white sandhills or ridges. The poor salty nature of this white sand is indicated by *Melaleuca pauperifolia* ("tea-tree"), the main tree growing on it. (This is also found on the edge of salt creeks on the tableland.) There is little or no undergrowth, though *Enchylaena tomentosa, Rhagodia nutans*, and *Zygophyllum ammophilum* were not uncommon with "pop-saltbush," "nigger-bush," *Myriocephalus Stuartii, Swainsona phacoides*, and *Emex australia* among the more sparsely scattered trees.

(3.) Vegetation of the Flats.

Flats of varying extent are found between the sandhills on the plateau, as near Yeltacowie and Arcoona homesteads; also covering large tracts of the surrounding country (Recent to Pleistocene), which is sometimes more or less undulating and interspersed with sand-ridges as is much of the country round Island Lagoon and on Oakden Hills and Yudnapinna stations. The soil varies from being sandy or a light red sandy loam to firm, fine clay particles almost merging into a claypan. Though the vegetation of the sandy loam flats has features in common with that of the sandhills and there are transitional stages between the two, the general aspect differs greatly. There is a greater variety and abundance of species, particularly on the well-colonized flats than on the sandhills, but the proportions of the life-forms are similar; small shrubs and trees (37·5%) are dominant on the flats, while there are also 11·5% chaemophytes. 31% therophytes and 14·5% hemicryptophytes.

(a) Myall Association on the Loam Flats.

The dominant or character tree throughout large areas of the flats is the myall *(Acacia Sowdenii)*, which is extremely drought-resistant, more so than even the mulga, but unlike the latter is of little use as a fodder plant. On the hot bare plains its dense needle-like foliage provides a welcome if not very dense shade, and so must have an influence on the growth of shrubs and ground vegetation. Several species such as *Encylaena tomentosa, Rhagodia Gaudichaudiana*, and the parasitic *Exocarpus aphylla* are usually found growing round the bases of myall trees.

The dominant species in the shrub stratum is usually the bluebush. *Kochia sedifolia* and *K. pyramidata* may be associated with each other or form separate

consociations, *K. sedifolia* is perhaps more common in the climax and sub-climax associations, where it may be associated with or replaced by the saltbush *Atriplex vesicarium* and *A. stipitatum*. *K. pyramidata* is more frequent on sandy patches and slopes, round the edge of claypans and in subseres where the vegetation has been disturbed by fire, drought or over-stocking.

The other common shrubs found in the myall association of the loam flats are:—*Myoporum deserti, Eremophila Paisleyi, E. Duttonii, E. longifolia, E. oppositifolia, E. maculata, E. Latrobei, Dodonaea lobulata, Pittosporum phillyreoides, Cassia eremophila* var. *platypoda, Eucarya acuminata,* and *E. spicata. Heterodendron oleifolium, Templetonia egena* ("broom bush," used for thatching), *Eremophila glabra* and *Cassia Sturtii* ("blood bush") occur frequently, either as single species in the myall association or as dominant species of societies which may exclude the association dominant. Several distinct strains of *C. Sturtii* were found on the flats.

Myoporum platycarpum, so-called "sandalwood" by bushmen, often a fairly large tree from 5-10 metres high, occurs frequently on the larger more established flats where the soil is deeper; while mulga and *A. Burkittii* appear on sandy patches and on the rises.

The ground vegetation and succession of aspect societies after winter and spring rains resemble those of the sandhills; some species prefer one habitat to the other, *Podolepis capillaris,* wild violet, geranium, and some grasses being more common on the myall flats. *Helipterum polygalifolium, Senecio Gregorii, Zygophyllum prismatothecum, Z. fruticulosum, Pappophorum avenaceum,* and *P. nigricans* are found on the flats, while *H. floribundum, Helichrysum apiculatum, Z. tesquorum, Z. apiculatum,* and *Senecio lautis* prefer the sandhills. On the mulga flats spinach and *Myriocephalus Stuartii* are most common. *Bassia obliquicuspis, Stipa nitida,* and other grasses came after summer rains, while in winter, after a drought, there was little on the bare ground but *Salsola Kali, Babbagia,* and bindyi.

(b) Colonization and Succession on the Flats.

Claypans may represent the prisere stage in the colonizations of the flats, but for the most part they are quite devoid of vegetation (the larger ones being bare, except for occasional colonies of *Nicotiana glauca* and *Spinifex parodoxus,* which form large tussocks on mounds of sand). In others, where water sometimes lies, *Kochia brevifolia* is the first colonizer of the hard-baked, cracking clay; this is also found near salinas. Then follow *Babbagia,* samphire on mounds, with some scattered saltbush, surrounded by bluebush, starbush, bindyi, and *Rhagodia.*

The smaller flats among the sandhills on Yeltacowie and Arcoona were colonized by bluebush, *Babbagia,* bindyi, samphire (round the edges usually), buckbush, and *Crinum pedunculatum* ("36-hour or Murray lilies"). *Kochia sedifolia* becomes dominant with *K. pyramidata,* which may replace it on the slopes, sand patches or at the edge of a claypan, where *Phyllanthus Fuernrohrii* also occurs.

As the soil develops *K. aphylla* ("cotton-bush"), star-bush, hop, *Acacia ligulata* and, occasionally, boxthorn come in, particularly round the edges. For the most part these are the only plants, but grasses such as *Stipa nitida* and annuals occur in season. Pure bluebush flats are not uncommon, but occasionally *K. Georgei* may be mixed with the *K. sedifolia,* especially where the loam is deeper.

Then the myall establishes itself and a typical myall-bluebush *(K. sedifolia–K. pyramidata)* associes develops. At first there are perhaps just those three species, with the annual ground covering in season, then come in the shrubs and undershrubs already described for this association. As the soil becomes more loamy and deeper mulga and saltbush appear, until patches of pure mulga-saltbush

may result, particularly on the sandy parts, for in this region mulga is nearly always an indicator of sand (pl. iv., fig. 2).

On most parts of Arcoona and Yeltacowie an association built up of these two consociations represents the climax, whether it be an edaphic climax due to the limited size of the flats or a climatic climax limited by the slightly lower rainfall which excludes the frequent occurrence of *Myoporum platycarpum*. This tree is very infrequent on the plateau, occurring very rarely below the 6-inch isohyet, is scarce and scattered between that and the 7-inch isohyet, while between the 7- and 8-inch isohyets, as on the extensive flats outside the plateau, on Carriewerloo, Yudnapinna, and parts of Oakden Hills it is very common, mixed with the myall, and in some places being the dominant species in abundance as well as size (pl. iv., fig. 3). Towards the southern and western boundaries of these stations one crosses the 8-inch isohyet, and immediately mallee is found, at first mingling with the myall, mulga, and *M. platycarpum,* then gradually replacing them as more typical mallee scrub is developed. Thus *M. platycarpum* may be an indicator of slight rainfall variation between the 6–8-inch isohyets. It also appears to need a certain depth of soil and a sandy mulch.

Under normal conditions it would thus seem that the myall-bluebush association is a sub-climax on the rather hard, bare clay or loamy flats, and the mulga-saltbush association a sub-climax on the more sandy parts. Only on the larger loamy flats, where the soil is deeper, can the true climax association develop, with myall trees of considerable size as the most frequent tree, but with tall *M. platycarpum* giving height and character to the scrub, and with mulga also frequent, either mixed with the myall or forming locally dominant consociations on the sandy parts. In this climax association saltbush, where not killed by drought or eaten out by stock, is dominant in the lower stratum, though *K. sedifolia* is also frequent and may take the place of the saltbush should the stability of the latter species be disturbed. *K. pyramidata* is the most hardy of the three and will thrive where little else will grow, and will choke out the other two species provided that adverse conditions give it a chance to establish itself.

(c) Regeneration.

After the exceptionally heavy rains of 1920-1921 there was such an abundance of grasses and annuals on the flats that when, in the following year, a bush-fire started in the dry feed it spread throughout the district, destroying much of the myall-mulga *(M. platycarpum)* scrub on parts of Oakden Hills, Yudnapinna, and Carriewerloo stations. As the annual rainfall gradually fell during the following years, to culminate in the drought of 1928-1930, regeneration has necessarily been retarded—if, indeed, complete regeneration be possible on bad patches that are already deteriorating with drifting sands. When viewed in March, 1930, after the summer rains, this burnt country was still very barren; the "nigger-bush" *(K. pyramidata)* being the only shrub which had survived to any extent; this plant is remarkably hardy, and also thrives on country which has been "eaten-out" or drought stricken. The common bluebush *(K. sedifolia)* was also found, but less frequently. The bullock-bush *(Heterodendron oleifolium)*, another extremely hardy shrub or small tree, often survived, either in isolated cases, or more often in small colonies which were spreading. In many cases these shrubs were sprouting again and growing quite vigorously, after having, apparently, been dead for some time.

This scrub, like saltbush and "nigger-bush," may actually benefit from judicious pruning; mulga, *Cassia* and *M. platycarpum* will also stand a considerable amount; while other shrubs that are too harshly cut may never recover. Thus, where scrub-cutting is necessary, as in a bad drought, it is advisable that it should be done with restraint and discrimination, having due regard to the recuperative powers of the

various shrubs; it will often not be found practical to keep a few hundreds of sheep alive at the cost of destroying the natural fodder resources of the country for all time.

Stipa nitida was the most common grass on the burnt flats at this time, most of it having dried off by March; while *Bassia paradoxa* was another colonist of this burnt subsere. Miles of dead bushes of myall, bluebush, mulga, and saltbush were all that remained of good scrub country. Here and there a myall or two had escaped, but for the most part the plains were bare, except of scattered "nigger-bush," odd sprouting bluebush, colonies of bullock-bush, and very occasionally *Templetonia egena;* with, at times, *Lycium australe* in small patches where water had collected.

(4) Salinas and Fresh-water Swamps.

The saltmarsh association around the salinas and salt-lakes that are so numerous west of Lake Torrens resembles that found in similar places near the sea-coast and in similar places inland. Samphires are the dominant species. *Arthrocnemum halocnemoides,* var. *pergranulatum,* was found round the edge of Lake Torrens, near Sandy Point, while *Kochia tomentosa,* var. *appressa,* was growing in sand a few feet from the damp surface of the lake, with starbush and saltbush slightly higher up the banks.

The three most common types of fresh-water swamp associations were dominated, respectively, by "cane-grass" *(Glyceria ramigera),* "cotton-bush" *(K. aphylla)* and *"lignum" (Muehlenbeckia Cunninghamii).* In them a varied ground vegetation is often developed, including samphire, nardoo *(Marsilea Drummondii)* and *Cressa cretica.*

VI. VEGETATION MAP OF THE LAKE TORRENS PLATEAU.

In Prescott's Vegetation Map of South Australia (20) the whole region dealt with in this paper is marked as dominated by mulga and its allies, and also as lying within the limits of distribution of saltbush, bluebush and cotton-bush. Generally speaking this is correct, as such mulga associations have been shown to represent the climatic climax of the district. However, owing to edaphic limitations, the greater part of the Lake Torrens plateau can never support mulga scrub or mulga and myall consociations; the "gibber tableland" consists almost entirely of saltbush steppes, with an almost complete absence of trees, except in the creek-beds.

On page 90 is reproduced a vegetation map of the Lake Torrens plateau and its surroundings which gives the distribution of the three main associations dealt with in this paper, *i.e.,* saltbush on the gibber tableland and stony hills, myall on the flats, and mulga on the sandhills. In the case of the last two, it must be remembered that small flats with myall occur between the extensive sandhills, while the more definitely loam-flat country is often more or less undulating and intersected by sand-ridges with mulga.

The geological outlines of the plateau and its outliers are taken from Ward's Geological Map of South Australia (24), where they are marked as "Ordovician?" The distribution of the vegetation is based on the author's own observations and, also, especially in the part not described in this paper, from detailed survey plans kindly lent by the Surveyor-General, Mr. J. H. McNamara, and his predecessor, Mr. T. E. Day.

VII. SUMMARY.

The Lake Torrens plateau lies to the west of Lake Torrens, and consists of flat-topped hills and stony or gibber tablelands with patches of sandhills and clay or loam flats. It is surrounded by extensive loam plains intersected by sand-ridges, salt-water lagoons and fresh-water swamps. The part described in this

paper extends to Island Lagoon. The whole area lies between the 5- and 8-inch isohyets, and is part of Tate's Eremian Region.

Out of a total of 387 species, of which 31 are endemics and a small percentage of Northern or Central Australian origin, the flora is composed largely of migrants, almost equally divided between the Eastern and Western centres of distribution, as is the case also in the Gulf Region of this State, although the actual composition of the two floras is very different, only 43 being shared, the Lake Torrens Region having more in common with the drier parts of West Australia, New South Wales, and Northern Victoria.

Most of the species found are fairly widely distributed throughout South Australia, only seven being endemics confined to the plateau; most (81%) are shared with the Far North of this State, while 44% are found on the adjacent Flinders Range. Other floristical statistics are given.

The various geographic, climatic and edaphic factors influencing the ecology of the vegetation are described; an analysis of the life-forms is given in the spectra of the region and various habitats; and several compound species such as *Atriplex vesicarium* are discussed.

It would appear that the climatic climax for the whole region is an open scrub formation of the myall-mulga-*Myoporum platycarpum* type, with a saltbush-bluebush lower stratum among the various societies of larger shrubs that grow among the three main dominants. This climax can only be attained when optimum soil conditions prevail, *i.e.*, a certain depth of soil with a sufficient sandy mulch, such as is chiefly found on the plains surrounding the plateau; it may also be somewhat influenced by the rainfall. Hence different edaphic or sub-climaxes are developed on the three main habitats:—saltbush steppes on the gibber tableland; mulga scrub with bluebush or saltbush, according to the state of consolidation, on the sandhills; and myall-bluebush association on the hard loam flats with fine particles and firm clay soils, with mulga-saltbush on the sandy flats. These associations are described in detail with notes on succession, regeneration, etc.

The most interesting feature of the district is the widespread occurrence of samphire (chiefly *Arthrocnemum leiostachyum* and *Pachycornia tenuis)*, which were not only found round the swampy areas but were of frequent occurrence and widespread distribution on the rather saline soils of the tableland and flat-topped hills, associated with the saltbush.

A vegetation map of the district is given. No authority is given for the specific names, but the nomenclature throughout is that given by Black.

Acknowledgments.

The author wishes to thank Mr. and Mrs. G. P. Blackmore, late of Yeltacowie, whose hospitality made this paper possible in the first instance; also the Trustees of the Commonwealth Science and Industry Endowment Fund, for a grant which enabled her to complete it; and Mr. J. M. Black, for identifying and checking many of the more difficult specimens. She is also indebted to Mr. and Mrs. C. Martin, late of Arcoona, and the managers of other stations visited; to Mr. J. G. Wood, of the Botany Department of the University of Adelaide, for his helpful advice, loan of apparatus, etc., and to Messrs. Tom Kidman and A. Wellby, of Oakden Hills, for specimens.

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DESCRIPTION OF PLATE IV.

Fig. 1. Gibber tableland, South Gap, showing samphire *(Arthrocnemum leiostachyum)* with a little saltbush *(Atriplex vesicarium)* in right foreground.

Fig. 2. General view of myall *(Acacia Sowdenii)* and bluebush *(Kochia sedifolia)* flat between sandhills, Arcoona. Mulga *(A. aneura)* colony at left and on distant sandhills. *Salsola Kali and K. pyramidata* on slope in foreground.

Fig. 3. Loam flat near Bookaloo. Tall trees are *Myoporum platycarpum* with myall in the background; ground covering chiefly *A. vesicarium* mixed with *A. stipitatum* and *K. sedifolia; Eucarya spicata* (commercial sandalwood) is the dark shrub in centre, left of tallest tree.

THE DEAD RIVERS OF SOUTH AUSTRALIA
PART 1. THE WESTERN GROUP

BY PROFESSOR WALTER HOWCHIN, F.G.S.

Summary

At the Melbourne meeting of the Australasian Association for the Advancement of Science, held in 1913, the present writer gave a Presidential Address before Section "C" on "The Evolution of the Physiographical Features of South Australia." In that address special attention was directed to the revolutionary geological changes that occurred in Central and South-Central portions of Australia during the Pleistocene Period. In these earth movements a new coastal watershed was developed, with a correlative sag to the northward, which brought the Lake Eyre country below sea-level, and resulted in a general deformation of the hydrographic systems within the region concerned.

THE DEAD RIVERS OF SOUTH AUSTRALIA.

PART I. THE WESTERN GROUP.

By Professor Walter Howchin, F.G.S.

[Read September 10, 1931.]

Plate V.

Contents. Page.

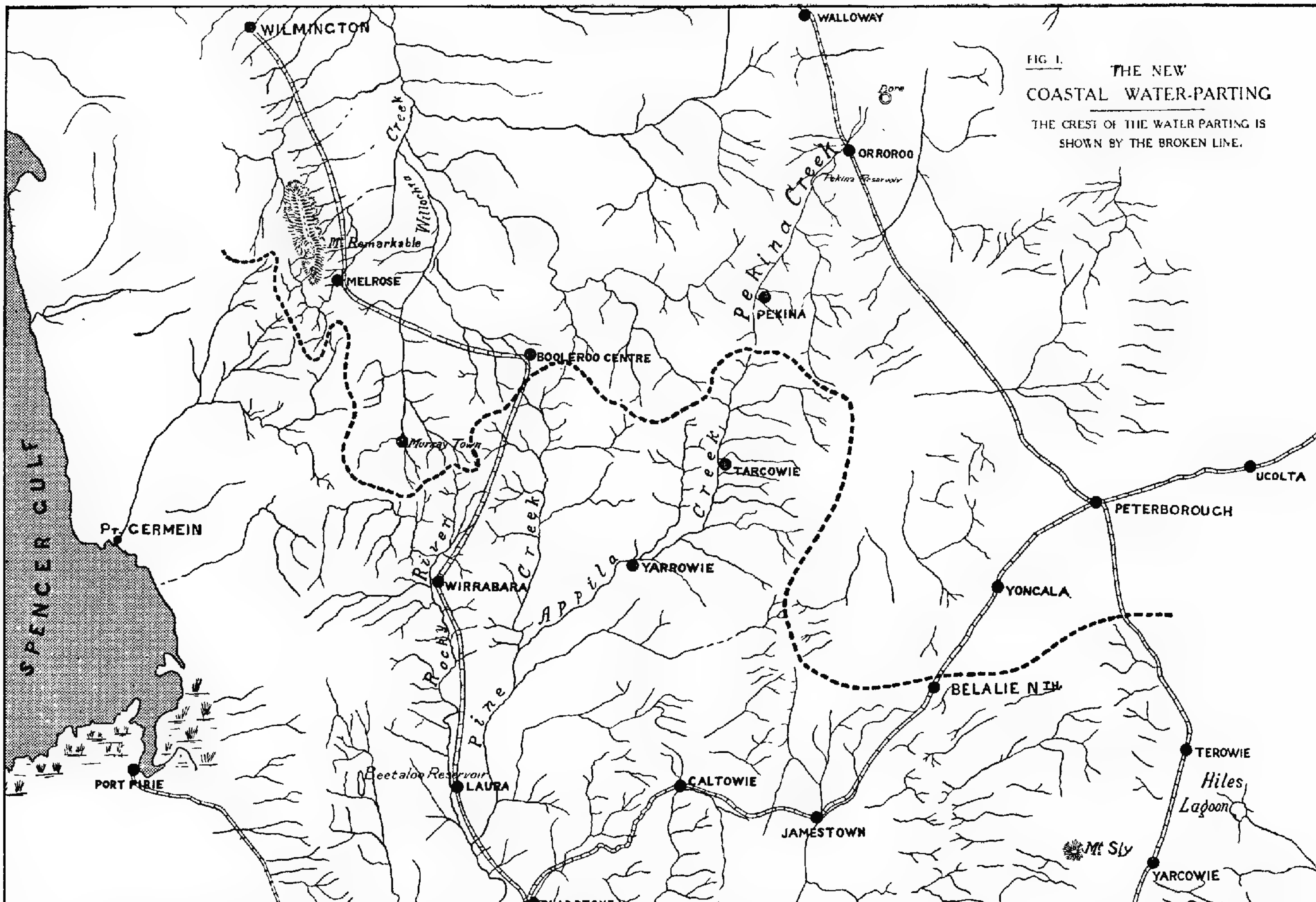

Fig. 1. Map of the crest of the New Coastal Water-parting. Illustrates the plateau-like summit and the fragmentary nature of the existing drainage system.

FOREWORD.

At the Melbourne meeting of the Australasian Association for the Advancement of Science, held in 1913, the present writer gave a Presidential Address before Section "C" on "The Evolution of the Physiographical Features of South Australia." In that address special attention was directed to the revolutionary geological changes that occurred in Central and South-Central portions of Australia during the Pleistocene Period. In these earth movements a new coastal watershed was developed, with a correlative sag to the northward, which brought the Lake Eyre country below sea-level, and resulted in a general deformation of the hydrographic systems within the region concerned.

The present paper is devoted to a consideration of the same subject in greater detail, including some features of the older continental watershed that is now in a state of decline; the development of a new water-parting, parallel with the coast; and also the delineation, as far as possible, of such ancient river channels, now mostly obsolete, that formed the western portion of the antecedent hydrographic system; leaving to a later paper the consideration of those defunct rivers that formed the eastern portion.

I. A SENESCENT WATERSHED.

There can be little doubt that the MacDonnell Ranges have through long ages formed the main central watershed of the country with a discharge of its waters to the sea at the southern coast, and, possibly, to the north as well. In their present condition they show an extensive Pre-Cambrian massif, reduced to a plateau of only moderate elevation, that originally formed the core and roots of mountain ranges that were of Alpine magnitude. The base of these now greatly-reduced ranges was laved by the waves of the sea in Cambrian times, and, later, by those of the Ordovician; and it is highly probable that the glaciers of the Finke, during the Permo-Carboniferous Period, had their source on the snow-fields of their summits; while, still later, they shared the scene with the palm-margined, fresh water lakes that made a characteristic feature during the Triassic and Jurassic Periods; and finally the sea returned during the Cretaceous Age, filling with its sediments the extensive basin caused by the slowly sinking land of the central region.

The marine and fresh-water sediments that were laid down during the successive geological periods must have been largely obtained from the waste of these ancient highlands reduced now almost to a common level. The general effects produced by such varied conditions of denudation and reconstruction have repeatedly changed the face of Nature throughout this vast region, and there is left the difficult task of disentangling and assigning their proper place to the residual land forms that have followed from such diversified phenomena. Some of the physiographical features date back to remote times, and may be anachronistic in relation to other surface forms with which they are immediately associated.

(1) It is to *the rivers* that we must look to obtain a clue to the events that more immediately preceded the existing order of things. The main lines of relief that prevail throughout these central highlands are remarkably simple and persistent. The strike is almost uniformly east and west. Ridges of rock form lines of outcrop that are continuous for many miles, and these prominent features are separated from each other by intervening valleys or plains, varied sometimes by minor swellings or by sandy flats smoothed over by wind-borne sands carried from the drier regions.

The rivers of the central highlands show some remarkable features. The river channels are commonly at right angles to the ranges, and are of a con-

sequent type. They originated in a former epeirogenic uplift of the region with low grades, in their initial stages, which led in many instances to a very serpentine course. The present features are those of a dissected plateau, with the rivers deeply incising and intersecting the hard ridges, forming numerous narrow gaps that mark the inlets and outlets of the river courses as the streams enter and leave the low intervening valleys.

The characteristic weathering of the region forms a striking illustration of weak atmospheric action incidental to a dry region, while the predominant solar control is seen in the nearly vertical walls of the gorges (rising frequently to several hundreds of feet), dislocated masses, that encumber the river beds, and river erosion, limited to intermittent floods which find their way through water-gaps that are often only a few feet in width. The gorges are as distinctive a feature in the smaller contributory streams as in the main water-ways, forming a region of entrenched meanders. The absence of waterfalls throughout this extensive region of highlands in Central Australia is a remarkable feature.

(2) *The geological history* of this somewhat complex region includes several periods of peneplanation, together with successive geological systems distributed over the Pre-Cambrian, Palaeozoic, Mesozoic, and Tertiary ages, with a central complex of great extent that probably has not been below sea-level from Pre-Cambrian times.

The material that has been removed from these primitive highlands by denudation has reduced their former height by many thousands of feet. That river action (and probably ice action as well) have been energetic agents in the transportation of this material is evidenced by the extensive deposits of alluvial sediments that occur throughout the central regions.

At the present time most of the drainage from the main watershed has a southerly direction. The chief rivers are The Palmer, The Hale, The Todd, The Hugh, and The Finke. The last named ultimately captures the others, forming a main or trunk stream. Some of the rivers, the Finke particularly, follow a very serpentine course, noted by all travellers, compelling the latter to leave the bed of the river, in many places, and for considerable distances travel parallel with the stream but on higher ground. [See Map in "Horn Expedition" and S. A. White's Map, Roy. Soc., S. Aus., xxxviii., 1914, p. 407.]

(3) In the *physiographic features* of the river systems there is a curious combination of mature and juvenile aspects. The reduction of grade in the river courses, absence of waterfalls, and intersection of wide valleys on a common grade with the hills, point to a mature condition; while the deeply-cut and narrow gorges are equally suggestive of a juvenile type. This blending of contrasted physiographic features can be explained by the peculiar climatic conditions under which the facial sculpture has been effected, viz., a limited rainfall and dry atmosphere affording only weak weathering effects, together with occasional floods and powerful stream erosion. The meandering of a great river, like that of The Finke, must have been initiated during a peneplanation stage that had reached a local base-level with low grade, followed by an epeirogenic uplift that led to the deep incisions of the river channels.

A marked feature of Central Australian geology is the enormous development of conglomerates of various ages, monoliths of which are seen in Ayers Rock, Mount Olga, and Mount Currie [Chewings], that indicate important rivers, of strong grades, and with adequate powers of transport. Such a vast and powerful hydrographic system must have had its outlet at the southern coast in former times.

The earth movements that produced the sag and lake basins across the main line of southerly drainage, until its central region sank below sea-level, had the effect of integrating the drainage both on its eastern and western sides. The western affluents of the River Murray were captured on the one side, and those draining from the Musgrave Ranges on the other. If Lake Eyre was brought up to the level of Lake Torrens (a difference of about 100 feet) the Cooper and other affluents that now find their way into the eastern side of Lake Eyre would have to find an outlet further to the east. Prior to the east-west uplift, with its concomitant sag to the north, these streams probably united with the Darling, or took a course through the gap that occurs between Cockburn and Broken Hill and united with the Murray; or, possibly, following a course more to the westward, found an outlet in the direction of Lake Frome. Cockburn is at present nearly 700 feet above sea-level, but this presents no difficulty, as it is included within the limits of the raised area, which has a value much exceeding that height.

II. DEVELOPMENT OF A NEW WATER-PARTING.

It is generally accepted that during the late Pliocene or early Pleistocene periods there was an extensive movement of plateau elevation in southern Australia. In South Australia the uplift took the form of a broad and gentle geanticline parallel to the coast, the summit of which, in a line with the Northern railway, is situated at an average distance of about 150 miles from the seaboard. The limbs of the anticline extend, respectively, from near Adelaide, in the south, to Marree, northward, where the beds dip under the Cretaceous clays of the Lake Eyre basin. The summit of the fold is marked by the dividing of the drainage, in gravitating, either to the northward or the southward. By reference to fig. 1 it will be seen that this water-parting follows a very serpentine course. This outspreading is occasioned by the relative flatness of the summit and the influence of small differences in level in determining the direction of the streams.

If such a deformation has occurred in South Australia within so recent a time, as is believed to have been the case, it must have had a revolutionary effect on the river systems as well as on the climatic conditions of the country. The evidences that support this view may be briefly stated.

(1) *The Geological Structure of the Area.*—The fold takes the form of a simple corrugation (or geanticline), as already stated, in which the strata, rising from sea-level near Adelaide, carry rocks of the same geological horizon (although much faulted and distorted) over a bend, exceeding 2,000 feet in height, to sea-level on the northern side in a distance of 500 miles. [See fig. 2.]

(2) *A Topographical Incongruity,* where a central and ancient continental river system is blocked by a transverse land barrier in its discharge to the ocean, giving rise to an extensive development of inland lakes on the northern side of the barrier and a comparative absence of rivers on the southern.

(3) *The Physiographical Outlines of the Country* show that the main features of physical relief have had an origin antecedent to the present geographical cycle.

(4) *The Discordance of the Existing River Channels* in relation to the main features of the physical relief—the modern rivers often intersecting the antecedent river channels at various angles with a westerly tendency. This westerly direction (as opposed to a southerly one) has been caused by the great meridional fault of South Australia by which the country has received a tilt to the westward.

(5) *The Relatively Juvenile Stage of the Existing Rivers* in their erosive effects.

(6) *Blind River Channels,* now mostly dry, that occur on the raised barrier and that have no definite relation to the existing drainage.

(7) *Deep Alluvial Deposits* occupy these deserted river beds and, by absorption of the local drainage cause short stream-lengths, as laterals, that have an intermittent existence.

(8) *Secondary Silicification* often occurs in the older river deposits by which the silt, sands, and gravels are converted into extremely hard rocks that simulate rocks of much greater age and are often broken for road metal or are too tough for this purpose. Mostly situated at high levels.

(9) *Evidences of Far Transport of Material.*—When the sediments have been preserved in their original loose condition the pebbles are seen to be very highly water-worn. Some of these, consisting of quartz and as large as cricket balls, are often worn perfectly round, giving evidence of stream attrition having been carried on over long distances. Silicified wood is also not unfrequently found in these ancient gravels.

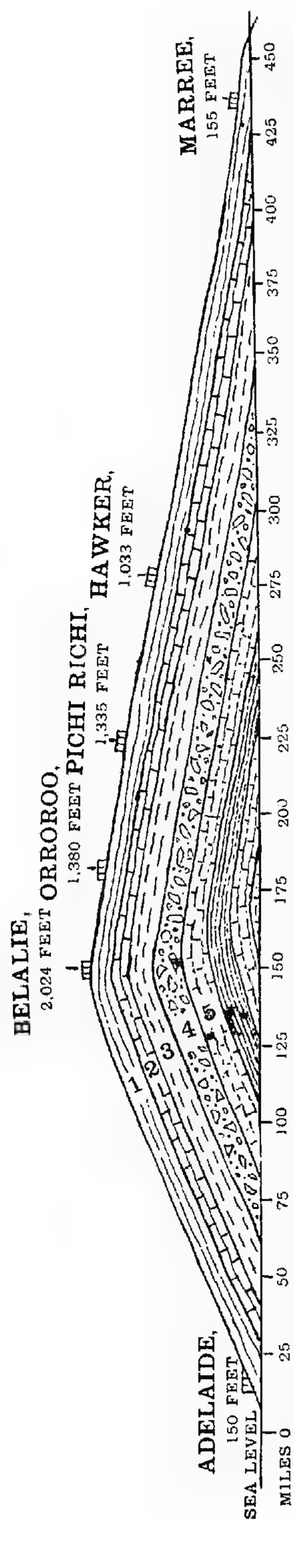

Fig. 2. Diagrammatic Geological Section of the New Coastal Water-parting. *Cambrian:* 1. Purple Slates and Quartzites. *Adelaide Series:* 2. Brighton Limestone. 3. Tapley's Hill Slates. 4. Sturtian Tillite. 5. Mitcham-Glen Osmond Slates and Quartzites.

III. THE BETRUNKED RIVER FINKE.

(1) *Lake Eyre.*—Many rivers converge at the northern end of Lake Eyre, the chief of which are The Diamantina, The Warburton, The Alberga, The Macumba, and The Neales. The Finke, in flood, may mix its waters with those of the Macumba, but is mostly lost by absorption before reaching Lake Eyre. As forming the chief water system of the MacDonnell Ranges it may be taken to represent the trunk river or chief channel of discharge to the Southern Ocean in the preceding geographical cycle of the region.

There is relatively low ground between the southern end of Lake Eyre and Lake Torrens with a slight gradient to the former. In this depression bordered by rises of over 500 feet, Chambers', or Stuart's, Creek flows northward into the southern end of Lake Eyre. In view of the development of the new water-parting we must assume that Chambers' Creek occupies the former channel of The Finke in its southward flow but, by earth movements, has been reversed in its direction. Prof. J. W. Gregory, in writing of Lake Eyre, says: "Its western rim is formed by the eastern slope of the apparently eternal platform of Western Australia. A detached fragment of its floor now lies at the northern end

of Lake Torrens and links the Lake Eyre basin to the Great Valley of South Australia." ["Dead Heart of Aus.," p. 146.]

(2) *Lake Torrens.*—Lake Torrens occurs in a wide plain bordered by the Flinders Ranges on the east and a plateau of moderate elevation on the west. The lake lies in a shallow depression near the highest part of the ridge between Port Augusta and Lake Eyre, a height variously estimated at a little more than 100 feet above sea-level. Port Augusta is about 40 miles distant from the southern end of Lake Torrens, following a down grade of about two and a half inches in the mile, scarcely sufficient to maintain a current, and is marked throughout by a succession of shallow claypans and swamps divided by several recognized "crossings" for traffic. In times of heavy floods Lake Torrens is reported to overflow and carries its fresh water down to the sea, causing the waters at the head of the Gulf to be muddy. Others consider that an overflow of Lake Torrens is improbable, and that the muddiness at Port Augusta is entirely caused by local flood waters. Taking into consideration the physical structure of the country and recent earth movements, with a fairly defined channel of drainage—northward to Lake Eyre and southward to Port Augusta—it seems highly probable that prior to the tectonic movements The Finke followed the direct and depressed channel to the sea, via the present, now elevated, channel of Lake Torrens.

(3) *Period of Great Fluvial Action.*—There are many indications that in the geographical cycle that preceded the present order Central Australia was blessed with a more abundant rainfall and more permanent rivers than exist today. We may assume that these more favourable pluvial conditions synchronized with the existence of the permanent ice-fields that occurred in south-eastern Australia and in Tasmania during the Pleistocene Period, accompanied by a lowering of the mean temperature throughout southern Australia, of which we have some evidence in the retreats to warmer latitudes of some molluscs formerly abundant in South Australian waters. In evidence of the former existence of permanent fresh-water rivers in Central Australia in excess of the present, teeth, scutes, and portions of skulls of crocodiles have been obtained from the eastern side of Lake Eyre as well as at Port Augusta; also teeth of *Neoceratodus* from the Lake Eyre basin. [See Howchin: "Building of Australia and Succession of Life," pp. 659, 661. Government Printer, Adelaide.]

At the time when the rivers of the central region came through to the southern coast the existing seaboard was probably at a higher elevation than at present, and Spencer Gulf was either non-existent or on a much smaller scale. Many of the islands at the entrance to the gulf are covered by dune sand. Wedge Island, one of the Gambier group, has a base of older rocks at about sea-level, on which rests a pyramidal mass of dune sand which, at its south-eastern angle, rises in an almost perpendicular cliff to a height of 660 feet, capped by travertine limestone. It is self-evident that such an accumulation of blown sand could not form on an island 20 miles from land. The inference is that within comparatively recent times Spencer Gulf either had no existence or was greatly narrowed in its limits—possibly to that of a delta of The Finke.

[For remarks on an ancient alluvial deposit at Port Moonta, see forward, Section VI., No. 9.]

IV. THE EXTINCT ARDROSSAN RIVER.

The remains of an important river occur near Ardrossan and for some distance southward, bordering the western side of Gulf St. Vincent. The most northerly position for these remains was noted in Section 77, Hundred of Cunningham. On the southern side of Ardrossan the alluvial beds form a

coastal scarp parallel with the coast and at an average distance of one mile from the latter. The beds which are consolidated and highly siliceous are very massive and strongly exposed. On the northern side of the district road that passes inland from Parara Head Station the beds form three terraces, resting on Cambrian limestone, in a vertical height of 100 feet, and 300 feet above sea-level. In their northern extension they rest on fossiliferous Miocene making a complete local occurrence three miles in length.

Similar consolidated alluvia form Rocky Point, situated 12 miles to the southward of Ardrossan. Rocky Point is 80 feet in height and carries diversified sediments, including petrified wood.

On the southern side of the jetty at Ardrossan are high cliffs that give interesting sections. The basal portion consists of indurated mottled clays of Pleistocene age. The upper surface of these clays shows subaerial erosion with Recent clays resting unconformably on the latter. There is thus in this neighbourhood three distinct sets of beds which are post Miocene and of discordant ages. (1) The high-level siliceous alluvia resting on a Cambrian floor, which is probably of Older Pleistocene age. (2) An indurated mottled clay series of Newer Pleistocene age. (3) And a Recent clay-bed of considerable thickness that occupies eroded valleys in the Newer Pleistocene. [See Howchin: "The Geology of Ardrossan and Neighbourhood," Trans. Roy. Soc. S. Aust., xlii, (1918), pp. 185-255, pls. xix.-xxix.]

The relationship which this now extinct river bore to the other ancient lines of drainage is uncertain, as it is isolated. Only the right bank of the river course has been preserved, the left bank having been submerged by the sea. The inference, based on geographical features, is that the river drained the plain on the western side of the Barunga and Hummocks ranges, and the northern portion of Yorke Peninsula, finally uniting with the trunk stream that flowed down the valley now drowned by the sea.

V. THE ANCIENT NORTHERN FLINDERS AND WILLOCHRA CREEK CHANNEL.

(1) *Western Plain of the Northern Flinders.*—The Flinders Ranges, in both their northern and southern groups, show a very bold scarp, facing westwards. This persistent feature is, without question, a fault scarp with a downthrow to the westward. This sunk-land, bordering the fault-scarp, has a uniform feature of fluvial and porous sediments. In its northern portions, the plain between Lake Torrens and the Flinders Ranges, has an average width of about 24 miles. In this section The Parachilna, Brachina, Hookina, and other creeks from the Flinders Ranges debouch on the plains and, after continuing for some distance, according to the volume of the flood-water, are finally absorbed and disappear below the surface. Whether these sediments were built up as alluvial fans from the ranges or were laid down by a former north and south river, now extinct, is not quite certain, but are probably the result of both agencies. That such a river, at some time, received the drainage of the eastern ranges, and flowed southward, is highly probable. In support of this view there is a clearly defined valley going south, in which the Willochra Creek, as a reversed stream, after flowing northwards for about 75 miles, takes a sharp right-angled turn to the west, at a distance of 24 miles from Lake Torrens, and falls into this lake.

As the Willochra Creek is the most important stream at the present time occupying the bed of the ancient river, it may be taken as the representative of the extinct trunk line of drainage now under consideration.

(2) *Melrose-Willochra Plain.*—This plain is defined on its western side by the Southern Flinders Ranges, its chief heights being, Mount Brown, near

Quorn, and Mount Remarkable, near Melrose. On its eastern side it is separated from the Orroroo plain by the Eurelia, Pekina, and Narien ranges. The railway line passes over this dividing ridge, at the following heights. At Orroroo, the railway station is 1,380 feet above sea-level; the line reaching its maximum height of 1,733 feet at Eurelia; descending on the other side to 1,510 feet at Carrieton; 1,386 feet at Moochra; 1,036 feet at Hammond; and then reaches the Willochra level at 783 feet at Bruce.

A well was sunk by Mr. G. H. Lehmann, four miles to the westward of Bruce [about half-way between Carrieton and Quorn], particulars of which were kindly supplied to me by his brother, Mr. F. H. Lehmann, as follow:—Clay and boulders, 115 feet; pure clay, 30 feet; white sand, 20 feet; then alternating clay bands and white sand to a depth of 199 feet, when the sinking was stopped without reaching bed-rock.

(3) *Booleroo Plain.*—Twenty-four miles to the southward of Bruce the Booleroo plain carries many evidences of extinct river action. Remains of the older and consolidated alluvia are frequently seen. Those portions of the fluvial sediments that have not undergone silicification have been subjected to denudation, while the silicified portions are, usually, more or less in relief and cover extensive areas.

The Booleroo plain extends into the western portion of the adjoining Pekina Hundred. On. Mr. Brooks' farm [Sec. 253, Hd. Pekina] and other paddocks in the neighbourhood, remains of the older sediments are very common. Travelling westward on the main road between Orroroo and Melrose silicified gravels occur on the southern side of the road a mile to the eastward of Booleroo Centre, also on the northern side of the road about two and a half miles to the westward of the same township. Both coarse and fine material have been cemented, taking the form of more or less spheroidal masses or large sheets of solid stone, which, if examined apart from its surroundings, might be mistaken for geologically-ancient quartzites. The surface of these stones and sheets is usually smooth (sometimes glazed) or irregularly mammillated, a feature that easily distinguishes this class of rock from other forms of alluvia, while the quartz grains retain their rounded form and have no crystalline continuity with the introduced silica which is of a colloid nature. As these consolidated masses occur scattered over the fields the farmers have much trouble with them. Some are gathered into heaps on the field or dragged to the boundary, but where the rock is in sheets and compact masses the only means of getting rid of it is either by blasting or the cheaper method of lighting a fire on the top to cause it to split.

I was informed that, in the south-west corner of the adjoining Hundred of Willowie, Mr. Chas. Fuller sank a well near his house, and at a depth of 20 feet entered sand, and that this was generally the case in the valley.

The bed-rock, when met with, is usually a decomposed kaolinized slate, as generally happens when slate occupies the bed of these ancient rivers. Mr. Brooks informed me that he put down a well in which he passed through 200 feet of pipeclay. At White Cliffs [Sec. 64 Hundred of Booleroo] a knoll has been worked back to a cliff 20 feet in height, consisting of kaolinized slate very white and apparently pure. It has been quarried and sent to Port Pirie for making retorts.

(4) *Mount Remarkable.*—Mount Remarkable, as already stated, forms a part of the western boundary of the Willochra plain. Saddle Hill, situated opposite to the township of Melrose, takes its name from the saddle-like shape of its summit, and is one of a series of foothills that surround the mount on its south-eastern and southern sides. The hill is roughly guessed as being 200 feet in height. The lower part, facing the Mount Remarkable Creek, consists of slates and thinnish beds of quartzite, more or less rotten. Resting

on this old shelf of rock are high-level gravels exposed on the side of the hill facing the mount where a gully has been cut out. These old gravels are capped by scree material. The Saddle Hill is connected with a still higher foothill behind it, estimated at 300 feet above the creek (which flows at the base of the mount), and the old conglomerate passes up the sides of this higher foothill which, latter, forms a ridge parallel with the mount. From this point a fine panoramic view is obtained of the Willochra plain, across to the eastern heights, which has all the appearance of having been at one time a great waterway. It does not seem at all likely that these high-level conglomerates had a local origin and are probably remnants of the older river system.

The Willochra Creek drains the highlands on either side of the plain, and takes its rise near the crest of the east-west fold, receiving numerous head-waters from the Bangor, Murray Town, and Booleroo districts.

(The Old Willochra Channel on the Southern side of the Water-parting)

Near the crest of the water-parting the drainage is much disjointed and, in many places, uncertain. Some residents in that region say that they are not sure in what direction the water ultimately flows, whether north or south. The direction changes from time to time, and is often regulated by the position in which the heaviest rain falls at different times. Townships situated near the summit, such as Peterborough, Yongala, Jamestown, Caltowie, Laura, Gladstone and Georgetown, are subject to flooding.

The extensive Willochra plain, as a physiographical feature, is continued across the water-parting where it is bounded on the eastward by the Narien Range, and on the westward by the highlands of the Wirrabara district. The respective lateral ranges feed numerous streams which follow the southern slopes of the transverse fold. Many of these unite. The three principal channels are the Rocky River, Pine Creek, and the Appila Creek; the two latter ultimately combine with the Rocky River, which finds its outlet by the River Broughton into Spencer Gulf.

(5) *Rocky River.*—Murray Town [Hundred of Wongyarra] is situated on the water-parting, with the Willochra Creek on the northern side and the Rocky River on the southern. At about a mile eastward from Murray Town is Pine Creek.[1] On the right bank of this stream, and at a height of about 50 feet above the water level, is a considerable deposit of siliceous and jaspery sandstone, sometimes changing to a coarse conglomerate having the features of the older river system.

The Rocky River, strengthened by tributaries, takes its rise in the high ground to the north-west of Wirrabara and, for a few miles, pursues a northerly course till, near the crest, it takes a sudden turn to the south-east, passing through Wirrabara and on the western side of Laura. The Rocky River answers to its name only in its upper reaches as, from Wirrabara, southward, the most of its bed is in the soft sediments of the older river channels. Near Wirrabara the river occupies a flood plain, meanders, and has incised its older bed, exposing black clay in its banks, the remains of a former swampy basin. A little further to the southward, between the 151 and 152 mile posts on the railway (about two miles north of Stone Hut), there are considerable deposits of the consolidated and siliceous gravels.

(6) *Pine Creek Tributary.*—Booleroo Centre, like Murray Town, is on the crest of the fold, at a height of 1,300 feet above sea-level. The country on the southern side of the above township has a very broken drainage for a few miles.

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[1] This creek flows into the Wild Dog Creek, the most southerly head-water of the Willochra Creek, and is quite distinct from a creek of the same name that takes its rise a little to the southward of Booleroo Centre, which will be referred to later. [See same page.]

The most persistent stream is Pine Creek which, with its origin in the Hundred of Booleroo, flows in a wide valley, southwards, through the Hundred of Appila and northern portions of the Hundred of Booyoolie, joining the Rocky River at Laura.

(7) *Appila Creek Tributary.*—This is the third important creek that, at the present day, crosses the wide valley lying between the Wirrabara hills on the west and the Narien Range on the east, forming part of the southern slopes of the transverse fold. Its head-waters are near the Hogshead Hill, Hundred of Pekina, and is the principal outlet for the drainage from the western side of the Narien Range. It passes through the Hundred of Tarcowie, and is there noted for a fine section of the Sturtian Tillite, half a mile in length, forming the most westerly gorge of the stream. [Howchin, W., "Glacial Beds of Cambrian Age in South Aust.," Q.J.G.S., lxiv., 1907, pp. 234-258.] At the mouth of the gorge a massive and nearly vertical quartzite underlies the tillite, rising like a huge rampart through which the creek is at present eroding its bed in rapids and waterfalls. On emerging from the gorge the creek enters the ancient valley and immediately loses its energy and fails to incise its bed, and, in places, overspreads the public road. At Yarrowie it is lost in swampy ground, but in flood times sometimes reaches Pine Creek.

(8) *Laura.*—The valley at Laura is bounded on its western side by the White Cliff Range, which forms the eastern boundary of the Wirrabara Forest Reserve. The Rocky River flows through the alluvial flats on the eastern side of the range mentioned and passes within half a mile of the township of Laura. The river is sluggish and has a pebbly bottom between waterholes. At a bend of the river, near Laura, the section shows sandy clay interspersed with beds of small gravel. The banks reach a height up to 20 feet. Laura is, unfortunately, situated with the Appila Creek and Pine Creek converging on the township, which occasions flooding and has necessitated the erection of mud banks to protect the township. Pine Creek comes in from the north-east with alluvial banks which, in places, are 20 feet in height, and, in others, flows across the main road at water-level in the form of several branches. The flow of water in the creek has been intermittent. It is supposed that, at times, the water finds an outlet through other channels. Near the Laura Railway Station a quarry has been worked in a gritty, mottled red and white sand-rock, having a visible thickness of 15 feet without the floor being exposed. The bed forms a terrace which was probably laid down by alluviation during the older river system.

(9) *Gladstone.*—After passing Laura, the valley of the Rocky River continues in the same direction to near Gladstone, a distance of seven miles, with a fall in altitude from 813 feet at Laura, to 740 feet at Gladstone. The railway from the south, after following a moderate plateau, passes down into the Rocky River valley, which is a striking feature. The valley is a flood-built one, two miles wide—a well-defined flat—and carries heavy timber. Gladstone is above the flood level of the Rocky River, but is subject to inundation from the plateau streams which come in from the Caltowie country, on the north, including the Pinery Creek and the Yangya Creek, which unite to form the Pisant Creek, against which Gladstone has had to be protected by a drain. The Rocky River valley, near Gladstone, is separated from the Yackamoorundie Creek, on the eastward, which belongs to another main line of ancient drainage, by a low ridge. Near Gladstone the Rocky River faces the Mount Herbert ridge, and is deflected thereby to the south-west, following a serpentine course between the townships of Crystal Brook and Narridy, and, after taking a new direction to the north-west, unites with the River Broughton on the coastal plains. By this north-westerly bend the Rocky River intersects a former tributary of the main northerly stream that follows the Willochra channel. This extinct tributary came down from the

north-west and united with the main river somewhere in the neighbourhood of Crystal Brook or Narridy, to which our attention must now be directed.

VI. A NORTH-WESTERLY TRIBUTARY OF THE ANCIENT WILLOCHRA CHANNEL.

(1) *Plain on the Western side of the Southern Flinders Ranges.*—At the time when the drainage from Central Australia came through to the southern coast the two gulfs were, practically, non-existent, and the areas they now cover formed extensive gum-plains at a greater elevation above sea-level than at present. The Finke River, in its southern extension, probably followed somewhere near the central portion of the present Spencer Gulf. There would thus be a trunk line of drainage on the eastern side of the Southern Flinders Ranges [the Willochra channel], and another through Spencer Gulf. As the latter has a trend in a south-westerly direction, there would be a very extensive plain between the extended Finke River and the western scarp of the Southern Flinders. Within this latter area there appears to have been a tributary stream which took a south-easterly course and united with the trunk river which, in the line of the present Willochra Creek, followed the eastern side of the ranges, the two streams meeting in the neighbourhood of Crystal Brook or a little further to the southward.

At the present time the coastal plain from Port Augusta, southwards, to Port Pirie, has an average width of ten miles. Numerous small streams drain the Southern Flinders Ranges on to the plain, but of these only one or two are able to maintain their course to the gulf, being absorbed by a great thickness of alluvium. Mr. Henry Williams, of Telowie [Port Germein Plain], informed me that he had sunk several wells in this neighbourhood to a depth of 130 feet and passed through alternating beds of clay and gravel without reaching bed-rock. The same informant stated that the deepest well in the neighbourhood, up to that time [1904], was sunk by Capt. Kingcombe, to a depth of 180 feet, without touching bottom. Alluvial fans form aprons at the outlets of the small streams from the Flinders Ranges, but it is doubtful if they can account for the enormous deposits of alluvial sediments that extend over so wide a plain and to such unknown depths.

(2) *Port Pirie.*—A Government boring, carried out at Port Pirie, in 1898, reached a depth of 641 feet, the material from which was critically examined by the late Prof. R. Tate, who summarized the results as follow:—"Passing upwards from the Cambrian bed-rock [proved at 574 feet] there are 314 feet[2] of unfossiliferous beds, more or less carbonaceous. These indicate a land accumulation. . . . The succeeding 182 feet of sandy and clayey beds, though unfossiliferous, have so much the character of the overlying strata with marine shells that they may be reasonably regarded as forming part of the same series. The chief fossiliferous beds range between 90 and 150 feet, but in the midst of them, at about 130 feet, is a band of calcareous silt charged with *Plecotrema ciliatum,* in an excellent state of preservation. This pulminiferous mollusc is living at extreme high tide-mark in the marine marshes abutting on the Port Creek, whilst the fine calcareous silt is analogous to the shell-travertine which delimits the margin of an upraised Pleistocene sea-bed extending from Glenelg, *via* Dry Creek, to

(2) Tate's figures in this paragraph show discrepancies with those contained in his table of strata, which are as follow, with the classification modernized:—

Recent:	Surface clay and 2 marine horizons separated by a terrestrial zone	150 feet
Pleistocene:	Sand-rock, mottled clays, etc. (?)	210 „
„	Sand-rock, clays, bituminous clays, etc.	214 „
	Bed-rock at	574 feet

beyond Virginia. This ancient silt is indicative of an actual depression of 130 feet below high water-mark. . . . The total amount of depression is a few feet less than 150 feet below high water-mark." [Tate, Roy. Soc. S. Aust., xxii., pp. 68-71.]

This boring has several interesting features. It proves the bed-rock of the Adelaide Series at Port Pirie, in Spencer Gulf, as over 1,600 feet nearer the surface than in the Croydon Bore, near Adelaide. In the latter bore fossiliferous Miocene, as well as Older and Newer Pliocene beds, are represented, but are absent at Port Pirie. In the latter only two (other than the bed-rock) distinctive formations occur:—*(a)* a lower alluvial series with a thickness of 424 feet; and *(b)* 150 feet of fossiliferous silts of Recent age, including a zone of dry land conditions. The fossiliferous beds can be definitely referred to the raised (as well as sunken) estuarine beds of the Port Adelaide flats, but, what of the 424 feet of underlying alluvium? It is possible that it may represent, in this case, the fresh-water series that underlie the fossiliferous Miocene in many places, with the marine beds wanting; but the surroundings seem to suggest a more recent origin. The amount of land-wash carried into Spencer Gulf from either side, at the present time, is a negligible quantity. It seems more likely that the sands and carbonaceous clays of these beds represent the sediments of the older river system, when the drainage from the interior of the continent found its outlet to the south and before the sea had penetrated so far up the alluvial valley as the site of the present township of Port Pirie. [See below, Port Moonta, this Section, No. 9.]

From Port Pirie the valley goes in a south-easterly direction, now occupied by the River Broughton, which, from following a southerly direction, becomes reversed to a north-easterly one, passing the townships of Koolunga and Red Hill on its way to the sea.

In the Hundreds of Crystal Brook and Narridy there are extensive deposits of ancient river alluvia.

(3) *Crystal Brook.*—The stream, from which the township takes its name, flows through a rocky gorge until about half-a-mile from the latter, but, below that point, it has cut its way through clay and other alluvia, with banks up to 15 feet in height. On the rise of the hill at the back of the township, joined on to the parklands and situated behind Mr. Chas. Nailson's house, there is an ancient river flat margined by consolidated alluvium, having a fine grain and highly siliceous. The formation begins near the entrance to a large quarry worked for kaolin for the Port Pirie smelting works. The kaolin rock is really the Tapley's Hill slate rock that formed the bed of the ancient river, and was probably acted upon by the water of the stream causing its alteration to a very white and pure kaolin. The solidified alluvial beds, just described, after following a north-westerly trend, make an angle at the curve of the hill and strike north-easterly. The rock has the usual reddish stain and is developed in large tabular and rounded masses.

(4) *Narridy.*—The Hundred of Narridy adjoins that of Crystal Brook. In Section 220, close to the border of the Hundred of Crystal Brook, on Mr. W. F. Nicholls' land, on the northern side of the Rocky River, an ancient river flat caps a relatively high ground and the consolidated alluvium follows the curve of the ridge. Several exposures follow a north and south direction, the largest is 300 yards long by 60 yards in its greatest breadth. There are similar deposits on the ridge situated on the opposite side of the road, in Section 221, and at about the same elevation as the one just described. One of the most extensive deposits of this class of rock that the writer has met with occurs near the township of Narridy, situated about three miles in a south-easterly direction from those just described. The formation rests chiefly on the higher levels of the Narridy Creek, on its left banks, commencing on the parklands of the township and occurs at

intervals for about a mile in a direction westerly from the township. One solid mass covers about half an acre of ground, near the township. The exposed rock, facing the valley, has been undermined to some extent and large masses have fallen over, leaving a sheer wall of solid siliceous rock 12 feet in height. The scarp face of the rock appears to preserve the same level, as far as could be seen from the Narridy end, throughout its extent.

Mr. W. F. Nicholls informs me that the same class of rock occurs on either side of the main road to Narridy, about two miles out from Crystal Brook, in Sections 756w and 757 [Hundred of Crystal Brook]. This exposure is about midway between that at Crystal Brook and that on Mr. Nicholls' land, described above, so that the four exposures, being in a line, there is almost a continuous deposit between the townships of Crystal Brook and Narridy, a distance of about nine miles.

The valley is continued southerly to the township of Red Hill [otherwise Broughton], which takes its name from a prominent hill or ridge in its neighbourhood consisting of a reddish quartzite belonging to the Purple Slate and Quartzite Series of Cambrian age. The hill affords a good view of the plain, with the tortuous River Broughton sunk in the alluvium below surface level, and can only be recognized from the hill by the trees growing within its limits.

5. *River Broughton.*—The River Broughton takes its rise in a number of head-water streams, variously named, among the ranges to the westward of the Burra. While these tributaries pursue courses mainly longitudinal to the grain of the country, The Broughton, as the main stream, runs transversely to the ranges. From Yacka [Hundred of Yackamoorundie] the river has cut its bed through a country of subdued relief until, at about the dividing line between the Hundreds of Yackamoorundie and Koolunga, the river emerges from its gorge and enters on the wide alluvial plain of the older river system. From this point its course is a strongly characteristic meandering stream of canyon type, with steep banks about 15 feet to 20 feet above the normal level of the stream. Near the adjacent boundaries of the Hundreds mentioned the river has some interesting features. It has recently [observations made in 1911] cut its floor deeply into a black, tenacious clay that formed a prehistoric marsh or swamp. The stream is here divided, one portion flowing over a gravelly terrace [its original bed] at a high level, and the other flowing over the side into a black-mud-ditch six feet below. From the yielding nature of the material this difference of level has probably long since been adjusted. Near to the above feature the bed of the stream consists of a firmly cemented, coarse conglomerate with a scoured surface. In this hard bed the river has cut a trough four feet deep with steep walls and is cutting back by a waterfall. This indurated bed probably belongs to the older alluvium which occurs plentifully over this plain.

In the neighbourhood of the black-mud deposit several large pieces of a fossiliferous mudstone were found among the boulders, in the bed of the river, containing many fresh-water shells. Examples of this bed were also found, *in situ* in the banks, about 15 feet above the present level of the stream. In approaching the higher ground, near the boundary of the Hundreds, four or five river terraces can be recognized as marking former levels of the river. The Broughton is evidently a juvenile stream, and from the yielding nature of the material within its bed is undergoing rapid change. The river is apparently superimposd on the older system, the sediments of which it has eroded and, in places, laid down thick sediments within such eroded areas.

(6) *Koolunga.*—The Koolunga township is situated at the most southerly bend of the River Broughton, on a wide flood-plain consisting of fine silt with sandy patches. The secondary drainage of the plain is of a fragmentary kind confined to temporary streams that seldom reach the centre of drainage. Red Hill

is 300 feet above sea-level, and Koolunga cannot be much higher. From this position there is a gradual slope of the ground southwards to sea-level at the head of Gulf St. Vincent. I was locally informed that in flood times the river sometimes overflows its banks, especially between Koolunga and Red Hill, flooding both sides, but especially the southern side, where its inundation covers the land to a width of half a mile and fills up the shallow depressions between the river and Snowtown. This was, no doubt, the older line of main drainage, and at one section of the river course, where flooding takes place, the latter has built up levees by its sediments, so that the river appears to follow higher ground than the land on either side.

A special feature of the district is the occurrence of large rounded or irregularly-shaped masses of very siliceous rocks, caused by the infiltration of colloid silica and a consequent consolidation of the sand grains into a chalcedonized rock. The thickness of these siliceous layers varies from a foot or two up to six feet, probably more. The rock has a good choncoidal fracture which has been utilized by aborigines for the manufacture of their implements. These consolidated beds are not confined to the neighbourhood of the river but pass inland and occupy the tops of low knolls in paddocks that can be traced for miles. Mr. Jones, of Koolunga, informed the author that where they occur in paddocks, in a size too large to move and too hard to break, the farmers here, as noted elsewhere, light fires on and around the masses, when they split into pieces.

(7) *Snowtown and Bumbunga Plain.*—The two important rivers that have just been sketched; one that followed the southerly extension of the channel now occupied, in part, by the Willochra Creek; and, the other, a tributary that came in from the north-west, formed a junction on an extensive plain between Crystal Brook and Koolunga. On this plain the present Rocky River, Yackamoorundie Creek, and River Broughton converged in finding their way to Spencer Gulf. Had it not been for the downthrow to the west, by the great meridional fault, all these streams would have followed the plain southwards in the line of the great trunk drainage that came in from the north.

From Koolunga the plain widens out to the head of Gulf St. Vincent. From Brinkworth on the east, to Snowtown, on the west, it has a breadth of ten miles. From Blyth, on the east, to the western side of the Bumbunga Lake, it has a breadth of 19 miles. The plain is margined on the western side by the Hummock and Barunga ranges, and on the eastern by low ranges of the Adelaide Series. The southern portion of the plain is divided longitudinally by a low central ridge of the older rocks which probably divided two waterways in former times. The ancient line of drainage on the western side of the plain is marked by a large number of, so called, salt lagoons, the largest of which is the Bumbunga Lake, that is six miles in length and yields much commercial salt. The plain is continued southwards, where it is known as the Gawler and Adelaide plains; and on its western side has suffered drowning by the waters of the Gulf. The railway between Balaklava and Brinkworth, a distance of 37 miles, follows the base of the eastern ranges, the small creeks from which have cut deep canyon-like courses through the alluvial clays. Towards the centre of the plain sand-ridges occur which, in places, are affected by wind-drifts.

(8) *Port Wakefield.*—In 1879, the Public Works Department put down a bore near this township, in search of water, to a depth of 765 feet. [See Rutt, W., Trans. Roy. Soc. S. Aust., iv., 1880-1882, p. 41.] The upper 66 feet of the boring passed through two marine beds of Recent age, separated by a series of fresh-water alluvial beds. From the 66-feet level down to 302 feet, the section showed

various coloured clays, quicksands, sandstones, ironstones, and fragments of decayed wood, presumably of Pleistocene age. Bed-rock was proved from 302 feet to 765 feet, in blue shale. The section is closely analogous with that passed through on the verge of Spencer Gulf, near Port Pirie [see p. 124]. The two marine horizons, represented in each, being the upper and lower Recent fossiliferous beds commonly present at about sea-level near Adelaide. The freshwater alluvium, of 236 feet, underlying the Recent beds at Port Wakefield, corresponds to the 214 [or 424] feet of similar beds in the Port Pirie bore. As the latter probably marks the southern extension of a former northern river coming down from the western side of the Southern Flinders, so the boring at Port Wakefield probably penetrated the alluvial sediments associated with a similar river, now extinct, which came down the Snowtown plain into the former terrestrial flats now occupied by Gulf St. Vincent.

(9) *Port Moonta.*—Pleistocene terrestrial beds occur in the cliffs and on the beach at the jetty, Port Moonta. The geological face shows three very distinct formations. The lowest is a consolidated alluvium, which, on account of the infiltration of iron oxide and silica, possesses very diversified features. The sedimentary element varies from very fine silt up to gravel, changed by the introduction of colloid silica (as an interstitional cement) into a very compact rock. In the finest grade of sediment it takes the form of a translucent flint in irregular layers, the iron oxide showing as reddish streaks. The bed is not fully exposed but in the cliff-face has a height of 10 feet. It occupies the whole of the beach to low-water level, in a length of 200 yards. On the northern side of the jetty there are immense blocks which have been left, *in situ,* at about half-tides, which the sea has failed to break up in its encroachment on the land. Resting on this lowest bed is a highly-coloured, gritty, ferro-laterite, 10 feet in thickness, and on this latter is a light-coloured calcareous marl, in a thickness of 20 feet. At about the middle of this bed is a bed of rather large nodules of travertine, 18 inches in thickness, and near the top of the cliff, another bed of smaller concretionary nodules. The whole section is unusual. It can possibly be correlated with the alluvial beds present in the Port Pirie bore. The difference in the respective lithological features may be accounted for, partly, from their different positions. The beds at Moonta are situated 66 miles to the southward of those at Port Pirie, and 26 miles more to the westward; and while the Port Pirie beds are at a depth of 150 feet, and protected by a thick covering, the Moonta beds, at or near the surface, have been subjected to conditions favourable for collodial silicification. It may be that the Moonta occurrences form an isolated fragment of a tributary stream which, taking its rise on the higher ground to the eastward, went westerly and united with the main trunk river that flowed down the valley of the present gulf.

VII. ANCIENT RIVER CHANNEL BY LAKE FROME AND ORROROO.

(1) *South-Western Queensland Drainage.*—The sag in the earth's crust, which gave rise to the Lake Eyre Basin, revolutionized the hydrographic system of Western Queensland and directed to the westward many streams that formerly had a more direct course to the southward. The Barcoo, or Cooper's Creek, during heavy floods spreads itself over the plain and is many miles wide. Near Innamincka, the flood waters divide; one branch (The Cooper) goes westerly to Lake Eyre, another (the Strzelecki Creek), goes southward and fills up the group of lakes that form a semi-circle around the head of the Flinders Ranges, terminating to the southward, in Lake Frome, which forms a secondary basin, receiving its supplies from all sides. The most important tributary at the southern end is the Pasmore River, or Wilpena Creek, which takes its rise in the Flinders Ranges. The Siccus

River, discovered and named by Eyre (meaning *dry)*, takes its rise a few miles to the northward of Carrieton, and as a wide flood stream flows into the Pasmore River, another example of a reversed stream incidental to the earth wave.

(2) *Siccus River Plain.*—Between Lake Frome and Orroroo is a valley, or plain, several miles in width, having a gentle slope to the north, drained at its northern end, as described above, by the Siccus River. That this clearly-defined plain has been formerly the course of a great river is beyond doubt. The streams that drain into it from either side are soon lost by absorption in thick sediments of sand and gravel that have built up the plain.

(3) *Walloway Creek.*—The Walloway Creek takes its rise on the water-parting between the Orroroo and Willochra valleys, at a height of about 400 feet above the plains in the neighbourhood of Eurelia. After flowing for about ten miles in a south-easterly direction it takes a curve to the eastward and is quickly lost in the alluvium of the Walloway plain, which forms a part of the Orroroo plain. From the Walloway railway station the creek has cut a deep gorge through the rocks of the Adelaide Series and, towards the plain, the creek bed and sides exhibit a great mass of very siliceous consolidated gravels and sands that have no relation to the present deposits of the creek, which seem to rest unconformably on the older series. The thickness of the latter is not revealed, but they descend below the present level of the creek. They show regular bedding in vertical cliffs up to 20 feet, and extend along the creek in a continuous outcrop for more than a quarter of a mile, after which they become obscured by the recent sands and clays of the plains. [See pl. v., fig. 1.]

(4) *Lower Pekina Creek and Orroroo.*—The important Pekina Creek, situated on the northern side of the Orroroo township, is a roaring torrent in flood time, but never reaches further than two miles on the flat before it becomes absorbed. Near the place where the creek ends a Government bore, put down in 1907, reached a depth of nearly 600 feet, and was abandoned before reaching bed-rock.

The following are particulars of this bore. Height above sea-level about 1,315 feet.

	Thickness, Ft.	In.		Thickness, Ft.	In.
1. Loam	37	0	13. White Sand	28	0
2. Gravel and Clay	40	0	14. Fine White Sand	11	0
3. Sand and Limestone	1	6	15. White Clay	9	0
4. Yellow Clay	10	0	16. White Sand	8	0
5. Sand	0	6	17. Clay, White and Pink	52	0
6. Clay	68	0	18. Quartz Sand	2	0
7. Sandy Clay	5	0	19. White Clay	8	0
8. Various Coloured Clays..	168	0	20. Quartz Sand	18	0
9. Pipe Clay	20	0	21. Sand and Pebbles	17	0
10. Sand and Clay	27	0	22. Sand, Lignite and Clay	21	0
11. Clay	3	0	23. Quartz Sand and Clay	15	0
12. Soft White Sandstone....	14	0	24. Sandy Clay	8	0
			Total proved	591	0

The great thickness of fluviatile sediments, as proved in the above bore, without reaching their total depth, cannot be accounted for by the present discharge of alluvia from existing streams that find their way to the plain. There is also evidence that the present surface of the plain is being lowered rather than raised, as noted below.

The significance of so great a thickness of sediment having been laid down in this unusual situation is apparent. Orroroo is not much below the crest of the watershed. A water-parting is necessarily under the conditions of denudation and waste and is incapable of conserving such waste. The thick alluviation of the plain at Orroroo is proof that such sediments antedated the development of the newer water-parting. In the elevation of the transverse ridge the tilting of the ground (passing from a southward to a northern direction) would be gradual, and at one particular stage in this process of reversal the grade would become horizontal, forming a local base-level and rapid silting. This may explain the presence of thick sediments in the present Orroroo plain that accumulated under former conditions and at a later stage were elevated to a position near the summit of the ridge.

As the Pekina Range comes close up to the plain on its western side it is seen that the lateral drainage has been truncated by the lowering of the plain. Behind Mr. Judell's [now Mr. James Chrystall's] house, in Winowie Creek, near Orroroo, a fine section of the old gravels is seen resting on kaolinized shale. The cliffs, in places, are 40 feet high, and the undermining of the latter by the stream, operating on the soft underlying shales, has brought down great masses of the indurated gravel beds. The remains of an extinct lake in connection with the Pekina Creek, near Orroroo, consisting of a fresh-water limestone [*Chara*] and fresh-water molluscs in clay, reveal the presence of an ancient back-water from the river that once flowed southward along the adjoining plain. These lacustrine remains form a scarp and are now about 150 feet above the plain [See Howchin Trans. Roy. Soc. S. Austr., xxxiii. 1909, pp. 253-261, pls. xvii.-xviii. Also Howchin's "Geol. of S. Aust." (2nd ed.), figs. 145 (1-2) and 146.]

At Orroroo the valley-plain is about seven miles wide. At about two-thirds of the distance across, towards the Peaked Hill, there are low knolls of rotten slate much kaolinized. On these slates, Yadena Creek, fed by springs, occupies a shallow bed. The water in the creek is very salt and continues, more or less, for four miles, but has practically no current. The springs are evidently artesian.

On the eastern side of the plain between the low ridges of slates, mentioned above and the main range of the Peaked Hill, there are terraces of gravel and indurated sands. The fields are very stony. The alluvial terraces fringe the range and pass through the gap between the Peaked Hill and the Black Rock, marking a line of tributary drainage coming in from the north-east. The main plain was followed by the writer for 16 miles in a northerly direction, through the Hundred of Yalpara, the alluvial features being continued the whole of the way.

The central portions of the plain consist of very fine silt, or loess, but towards the margin, on either side, as already stated, the drainage lines are at discordant levels with the plain by truncation. This lowering of the level of the plain has been caused chiefly by wind action. The soft, loose soil, in a bared condition during the summer, is in constant motion by the wind at that season of the year. Mr. Bradley, who was resident engineer during the construction of the Pekina Creek reservoir, informed me that when surveying on the adjacent plain he sometimes counted as many as 26 whirlwinds in operation at the same time.[8] The Orroroo plains are a fruitful source of the high-level duststorms that obscure the sky in Adelaide during the summer.

Between Orroroo and Mannanarie, a distance of 20 miles, the valley is bounded on the western side by the Pekina and Narien ranges, and on the

(8) In the paper referred to above it is stated that the 26 whirlwinds occurred in one day. This was subsequently corrected by Mr. Bradley to 26 at one and the same time.

eastern by the Black Rock and Peterborough ranges. The rise of the ground to the southward causes the flood waters coming from the Mannanarie and Yatina districts to sweep in a broad sheet over the paddocks, crossing the railway a little to the southward of the Black Rock railway station, the line passing over a lengthy wooden viaduct under which the water finds a passage and spreads itself till absorbed in the light, sandy soil. At Yatina the public school teacher sunk a well in alluvial deposits to a depth of 60 feet without reaching bed-rock. Near the depth mentioned a fossil bone was found but not identified.

(5) *Caltowie.*—The valley from Orroroo is continued through the south-eastern portions of the Hundred of Tarcowie, into the Hundred of Caltowie, where it assumes wide dimensions that take in most of the Hundred with a low plateau in the centre, Caltowie Hill being the highest point. On the western side of the township there are some remarkable remains of the older river deposits, situated on the higher ground. In Section 152 [Hd. Caltowie], on the western side of the north and south road, there are large patches in cultivated ground. Some exposed blocks weigh several tons, and others have been dragged to the edge of the paddock, near the road. [See pl. v., fig. 2.] The stone is a light coloured (sometimes tinged with red), massive, very tough, fine-grained, siliceous rock, too tough to be used as road metal. A terrace of a similar kind occurs in the same paddock at a higher level. In Section 154 S, about half a mile from the preceding, in a south-easterly direction, is another capping of a like kind, but coarser in its texture.

(6) *Yackamoorundie Creek and Hundred of Yangya.*—The Yackamoorundie Creek takes its rise a little to the northward of Caltowie, and flows southward through the Hundreds of Yangya, Bundaleer, Narridy, and Crystal Brook, becoming outspread and marshy in the latter, overflowing into the Rocky River, and finally, by a junction with the River Broughton, reaches the sea. Throughout its course it is a juvenile stream, confined by mud banks that have been eroded in the sediments of the ancient Lake Frome-Orroroo valley as far as Georgetown; then, taking a westward direction, it intersects the more westerly parallel trunk line of drainage which represents the dead end of the Willochra channel, indicated, broadly, by the Rocky River valley. Of these two important ancient waterways, the more eastward has the greater elevation and is separated from that more to the westward by a broad plateau of moderate altitude.

In the Hundred of Yangya some important terraces of the ancient river deposits occur on the higher ground, about three and a half miles to the north-eastward of Gladstone, in a line with similar deposits in the Caltowie Hundred mentioned in the preceding paragraph. One of these forms the top of a rise, in Section 157, situated on the western side of the railway, and consists of a coarse conglomerate, strongly cemented, containing rounded pebbles, some of which had a length of five inches. A still more striking platform of these rocks occurs on the opposite side of the railway, in Section 160, capping a hill with large blocks that can be easily seen from the train, and which, on examination, proved to be a coarse conglomerate, composed almost entirely of white-quartz pebbles which, on breaking, fractured evenly with the matrix.

(7) *Georgetown.*—The productive and extensive valley, already noticed as passing through the Hundred of Yangya, maintains its features throughout the Hundred of Bundaleer, with the Campbell and Never Never ranges forming its eastern boundary. Georgetown is situated at the north-western angle of the Hundred, 896 feet above sea-level, which is 156 feet higher than Gladstone, on the western side, in the Rocky River valley. Georgetown is built within the flood areas of the Yackamoorundie Creek, a defect that has given much trouble to the residents of the township. The creek mentioned spreads out into an ill-defined

swampy channel, but in a westerly turn it becomes more defined and ultimately enters the Rocky River as already described. This ultimate westerly tendency in the existing river system is very marked.

(8) *Gulnare and Yacka.*—South of Georgetown the valley takes the name of the Gulnare Plain, margined by a continuation of the Bundaleer hills on its eastward side and the less prominent Mount Herbert ridge on the westward. The railway, going south, follows the valley. A little to the southward of Gulnare railway station, on the western side of the railway, a patch of consolidated alluvia occurs in ploughed land. A little further to the southward, on the eastern side of the railway, similar consolidated beds form an ancient river terrace. There is also a succession of such deposits following the banks of a small creek. Still further, on the western side, in grass land, there are several more exposures, near a farmhouse, including a hill showing extensive faces of the alluvial sediments.

The surface shows a gradual slope from Georgetown [896 feet] down to Yacka [563 feet], situated on the banks of the River Broughton. This river takes its rise in the Bald Hill Range, north-west of the Burra, and cuts its way transversely through, first, the Camel's Hump and Brown's Hill ranges, and then through the Bundaleer and Mount Gregory ranges in a rocky gorge to Yacka, from which, in subdued physical features, it flows westerly to Koolunga and Red Hill, and enters Spencer Gulf a few miles to the southward of Port Pirie. Between the respective ranges, just mentioned, is a subsidiary valley that carries three important tributary streams that have a north and south direction, and meet the Broughton in a knot near Spalding. These are the Freshwater Creek, coming in from the northward, and the Hut and Hill rivers, following parallel courses, come in from the southward. These will be referred to again in a further paper on this subject.

There are some remarkable deposits of gravels, both loose and cemented, in the neighbourhood of Yacka. In Section 96 [Hundred of Yackamoorundie], about a mile on the northern side of the township, there is a strong craggy hill capped by cemented gravels, 120 feet above the present level of The Broughton, held together in a siliceous and ferruginous matrix. Just south of Yacka railway station there are several railway cuttings in gravel, about 70 feet above the present level of the river. These beds are unconsolidated and have been greatly used in ballasting the line, and may be younger than the siliceous beds on the northern side of the river. In Section 160, on the southern side of Yacka, there is another very craggy hill, the cemented alluvia resting on older quartzites. These consolidated gravels have a north and south extension of about three miles, and from appearance (with less conspicuous gravelly character) continue nearly to the top of the saddle on the railway passing over to Brinkworth. Sandy Creek, which flows into the River Broughton on the southern side of Yacka, occupies the valley southwards, having its origin a little to the north-eastward of Brinkworth. In the Sandy Creek the following exposures of the siliceous alluvia were noted. Near the Yacka railway station, on the western side; at one and a half miles from the station, on slopes of the valley; patches at high levels on both western and eastern sides; two and a half miles from the station, on western side, a small hill is capped by these gravels, also a patch further to the southward; again, on ploughed ground, are numerous heaps of big stones gathered into centres on those *in situ*.

(9) *Rochester and Magpie Creek.*—The Sandy Creek, flowing northerly, takes its rise on a low ridge in the Hundred of Hart. On the same ridge and within a few yards of the latter are the head-waters of the Magpie Creek with a flow south-westerly. The last-named, formed by the convergence of three head streams near the school-house at Rochester, passes to the southward of Brinkworth and is absorbed in the sediments of the Snowtown plain. The consolidated gravels,

so prevalent in the valley of the Sandy Creek, pass over the water-parting into the Magpie Creek country, near Rochester, about four miles to the eastward of Brinkworth. Here are seen the most extensive and prominent displays of the ancient consolidated alluvia found within the State. [See fig. 3.] (4) The surface features are distributed over an area two miles square and make large patches of ground uncultivable. In Section 317 [Hundred of Hart], on the right bank of the more northerly of the tributaries of the Magpie Creek, exposures of these rocks cover half an acre. Between the northern and middle tributaries there is almost a continuous exposure (occurring at intervals of from three to four chains) for two miles, passing through Sections 317, 316, 311, 310, 304, and 305, in two lines, an upper and a lower one, some examples having a height of from

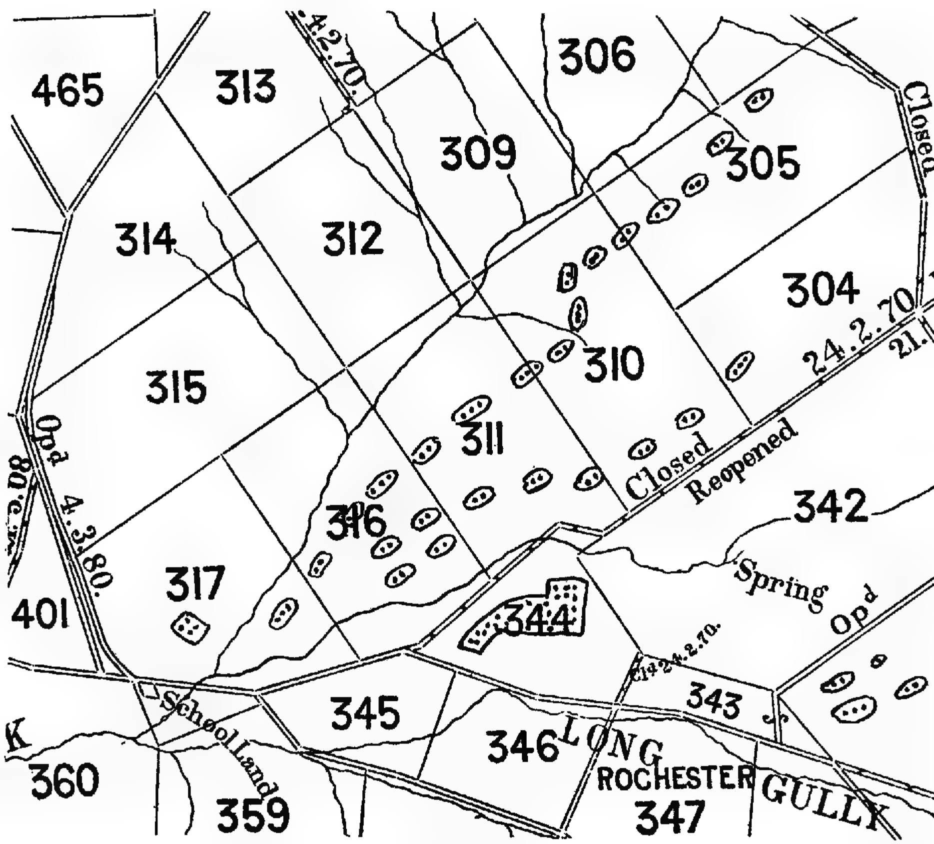

Fig. 3.

Part of Official Map of the Hundred of Hart [Scale, 2 in. to 1 mile], on which is shown the positions of the chief exposures of the Ancient Consolidated Alluvia in the neighbourhood of Rochester and head-waters of the Magpie Creek.

eight feet to ten feet. In Section 344 there is a very imposing display of these rocks, resembling vast megalithic structures. The group extends over 10 chains in length, by 6 chains wide at the eastern end, and 1½ chains at the western. The largest mass has a sheer face of 20 feet, and adjoining this are two great blocks with vertical faces to a height of 14 feet. The ground

(4) I am greatly indebted to Mr. Harold Snow, of Rochester (on whose properties most of these exposures occur) for kindly piloting me over the area and also noting on the map the respective positions of the principal occurrences.

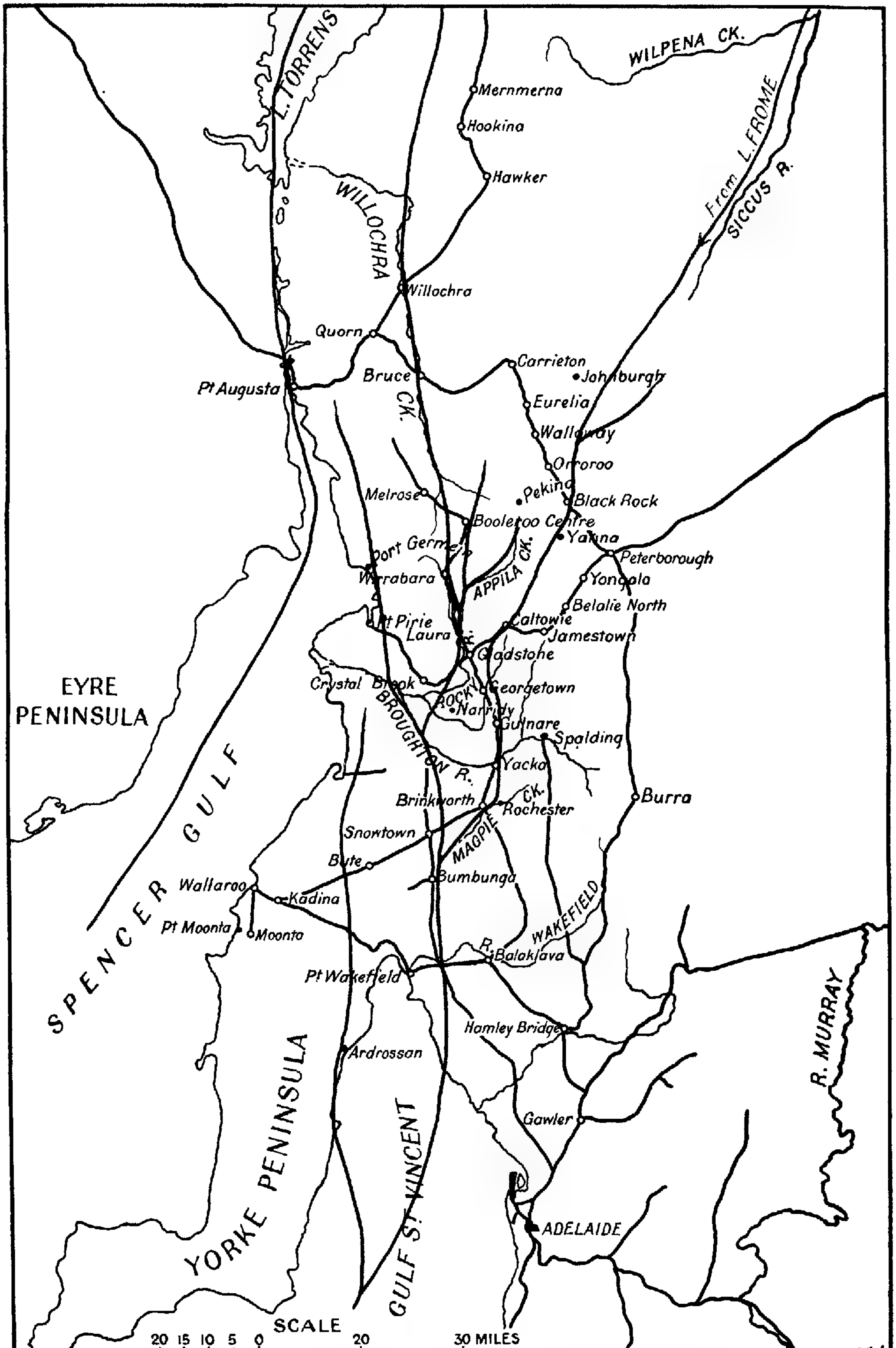

Fig. 4. Map of part of South Australia on which is shown, in red, the probable direction of some of the main river courses [the Western Group] before they were truncated.

covered by this patch of great stones is unploughable for 16 chains in one direction by an average width of 4 chains. At a mile eastward from the group just described [in Section 522] are several exposures. The three principal ones measure in circumference, respectively, 6 chains, 8 chains, and 10 chains.

Another somewhat isolated occurrence is seen in Section 454 [not included in the accompanying map], on the Michel Bros. land, about $1\frac{1}{2}$ miles north of the most northerly exposures of those shown in fig. 3, situated directly on the crest of the water-parting between Sandy Creek and Magpie Creek, and, therefore, forms a link between the occurrences found in these respective valleys.

This great field of ancient consolidated alluvia is unique. The local streams are small and at a juvenile stage. One has a small permanent spring, the others are mostly dry. The consolidated sediments vary in structure from fine sand up to coarse gravel, and are often current-bedded. The lower portion of Magpie Creek is cut in deep argillaceous alluvium of Recent age. So extensive an area of water-borne heavy material is suggestive of very strong transporting currents. From Yacka, southwards, there are indications of a great river, now extinct, that can be associated with the ancient Lake Frome and Orroroo trunk-waterway that drained portions of western Queensland, and found its discharge by union with another trunk line that came down the wide Koolunga and Snowtown plain to the southern coast.

As an indication of the thick alluvial that exists in the Snowtown plain the following quotation may be given:—"In August, 1886, I observed the flood waters of the River Wakefield coming down after a long continuance of dry weather, and the progress in its channel across the plain near Balaklava was only at about the rate of half a mile in 24 hours, and frequently the head of the flood remained stationary for half an hour whilst it poured into one of the many large fissures in the river bed."—Thos. Parker, C.E., "The Underground Waters of S. Aust.," Trans. Roy. Soc. S. Aust., vol. x., p. 84, 1888.

DESCRIPTION OF PLATE V.

Fig. 1. View of Ancient Consolidated Alluvia now undergoing erosion by the Walloway Creek.

Fig. 2. Ancient river terrace of Consolidated Alluvia exfoliating into large siliceous masses. Another terrace, at a greater elevation, can be seen in the distance. Hundred of Caltowie.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA. NO 29

BY *J. M. BLACK, A.L.S.*

Summary

Eragrostis japonica (Thunb.) Trin. in Mem. Acad. Petersb. ser. 6:1:450 (1830) instead of *E. tenella,* Bentli. Fl. Aust. 7:643 (1878) non Beauv. Or E. *interrupta,* Stapf non Beauv. var *tenuissima,* Stapf in Fl. Brit. Ind. 7: 316 (1897) ; Black in Trans. Roy. Soc. S. Aust. 48: 253 (1924) ; *Poa japonica,* Thunb. Fl. jap. 51 (1784). Miss C. D. Niles and Mrs. Agnes Chase in "A Bibliographic Study of Beauvois' Agrostographie," published in Contrib. U.S. Nat. Herb. 24:6:135-214 (1925) show that E. *interrupta,* Beauv. Agrost. 71 (1812) was based on *Poa interrupta,* R. Br. Prodr. 180 (1810), which is classed by Bentharn as var. *interrupta* of E. *Brownii,* Nees, and cannot therefore be applied to the minute-glumed species which extends from Australia to Japan. Besides, *Poa interrupta,* R. Br., is invalidated by the earlier name *Poa interrupta,* Lamk. Tabl. Encycl. 1:185 (1791), which is perhaps the same as the still earlier *Poa japonica.* (Fig. I.).

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.

No. 29.

By J. M. Black, A.L.S.

[Read October 8, 1931.]

Plate VI.

Gramineae.

Eragrostis japonica (Thunb.) Trin. in Mém. Acad. Pétersb. sér. 6:1:450 (1830) instead of *E. tenella,* Benth. Fl. Aust. 7:643 (1878) non Beauv. or *E. interrupta,* Stapf non Beauv. var *tenuissima,* Stapf in Fl. Brit. Ind. 7:316 (1897); Black in Trans. Roy. Soc. S. Aust. 48:253 (1924); *Poa japonica,* Thunb. Fl. jap. 51 (1784). Miss C. D. Niles and Mrs. Agnes Chase in "A Bibliographic Study of Beauvois' Agrostographie," published in Contrib. U.S. Nat. Herb. 24:6: 135-214 (1925) show that *E. interrupta,* Beauv. Agrost. 71 (1812) was based on *Poa interrupta,* R. Br. Prodr. 180 (1810), which is classed by Bentham as var. *interrupta* of *E. Brownii,* Nees, and cannot therefore be applied to the minute-glumed species which extends from Australia to Japan. Besides, *Poa interrupta,* R. Br., is invalidated by the earlier name *Poa interrupta,* Lamk. Tabl. Encycl. 1:185 (1791), which is perhaps the same as the still earlier *Poa japonica.* (Fig. 1.)

Eragrostis confertiflora, n. comb. instead of *E. interrupta,* "Beauv." var. *densiflora,* J. M. Black in Trans. Roy. S. Aust. 48:253 (1924); Fl. S. Aust. 674 (1929). In raising this variety to specific rank it became necessary to change the varietal name, because of the existence of *E. densiflora,* Rendle, Cat. Welw. Afr. pl. 2:244 (1899) a species of tropical Africa. (Fig. 2.) Gramen gracile glabrum, 20-40 cm. altum, culmo binodi; foliorum laminae 3-6 cm. longae 1-3 mm. latae, vaginis longiores; ligula brevissima, truncata, ciliolata; panicula erecta, spiciformis, 6-11 cm. longa, 5-8 mm. diam., basin versus interrupta, ramis erectis, revera solitariis sed interdum glomeratim approximatis, 5-20 mm. longis, usque ad basin dense vestitis; spiculae subsessiles, confertae, 2-3 mm. longae, 4-5-florae; glumae acutae, exteriores uninerves, prima $\frac{1}{2}$ mm., secunda $\frac{3}{4}$ mm. longa, florifera 3-nervis, 1 mm. longa, palea omnino glabra; stamina saepius 2; caryopsis ovoidea, brunnea, nitens, $\frac{1}{2}$ mm. longa.

Eragrostis Kennedyae, F. Turner in Proc. Linn. Soc. N.S.W. 19:535 (1894). Wirraminna, between Lakes Gairdner and Hart; May, 1931; coll. Hon. G. F. Jenkins. A slender grass, with narrow and spike-like panicle, or the branches sometimes spreading slightly, and minute purplish 3-5-flowered hyaline spikelets, the flowers almost globular and only $\frac{1}{2}$ mm. long; the outer glumes 1-nerved, obtuse, ciliate on the nerve and at apex, the lower one $\frac{1}{2}$ mm. long, the upper one $\frac{3}{4}$ mm. long. The terminal flower is very small, apparently always barren, and falls off early. The type came from Wonnaminta, near Broken Hill, and specimens have been collected on the River Darling and in the Murchison district, W.A. The species has, therefore, a wide distribution, although it has not been previously recorded in South Australia. The only difference perceptible in the West Australian specimen (which is in the Sydney Herbarium), is that there are some long hairs at the orifice of the leaf-sheath and the blades are rather flatter. (Fig. 3.)

The relative position of these three species may be explained by the following key:—

Rhachilla fragile, disarticulating between the flowering glumes, which fall off with their paleas and ripe grain; panicle-branches mostly solitary, divided and clothed with spikelets to base; glumes and grain minute, the latter brown, shining, barely ½ mm. long; palea-keels glabrous. (Section *Cataclastos*).

- Panicle rather loose; spikelets 4-12-flowered, 2-3 mm. long; flowers oblong; outer glumes subequal; stamens usually 2 .. .. .. *E. japonica*
- Panicle usually dense, spike-like; spikelets densely crowded; outer glumes unequal.
  - Panicle always dense, 5-8 mm. diam.; ligule short, ciliolate; spikelets 4-5-flowered, about 2 mm. long; flowers oblong; flowering glumes twice as long as adjacent outer glumes; stamens usually 2 .. *E. confertiflora*
  - Panicle 3-5 mm. diam., or sometimes broader, owing to the slightly spreading branches; ligule a minute rim of hairs; spikelets 3-5-flowered, 1-1¼ mm. long; flowers almost globular; flowering glumes not or scarcely exceeding the adjacent outer glumes; stamens usually 3 .. .. *E. Kennedyae*

Eragrostis infecunda, n. sp. Gramen perenne, stoloniferum; culmi ascendentes, rigidi, longi, glabri, 6-20-nodes, ad basin bulbosi; foliorum laminae involuto-subulatae, infra glabrae, erectae, 3-8 cm. longae, vaginis glabris multo longiores, inferiores planiusculae, 2-3 mm. latae; folia infima ad vaginas rigidas albas reducta; ligula ex annulo brevium pilorum constans; panicula coarctata, 3-10 cm. longa, 1-2 cm. diam., ramis solitariis, fere simplicibus, puberulis; pedicelli subnulli vel usque ad 2 mm. longi; spiculae paucae in quoque ramo, 3-8-florae, 7-12 mm. longae, circ. 1½ mm. latae, floribus saepe distantibus in rhachillâ plus minus flexuosâ; glumae exteriores hyalinae, uninerves, in carinâ scaberulae, prima circ. 3 mm. longa, secunda 3½ mm. longa; glumae florentes fuscae, glabrae, ovatae, 3½ mm. longae, 3-nerves, nervo mediano percurrente vel brevissime excurrente, lateralibus dimidio brevioribus; palea fere aequilonga, non persistens, carinis glabris; antherae 3, lineares, vix 2 mm. longae; styli ad basin coaliti; caryopsis adhuc non inventa.

Along the Gilbert and Wakefield Rivers near Riverton, and apparently propagating itself by the long rooting surface runners rather than by grain. The collector, Mr. Worsley Johnston, after careful search during March and April of this year, was unable to find any fruits. Until ripe fruits are discovered, it is difficult to say how the rhachilla breaks up, although it is apparently not persistent. In its straggling, wiry stems, and its rather loose spikelets, this grass bears some resemblance to a slender form of *Glyceria ramigera*, but in the latter species the midnerve of the flowering glume ends at some distance below the summit, while in *Eragrostis infecunda* it is always percurrent. (Fig. 4.)

Agrostis limitanea, n. sp. Gramen caespitosum, perenne, 30-45 cm. altum; culmi graciles, rigiduli, erecti, 2-4-nodes; foliorum laminae erectae, superne involuto-subulatae, 4-12 cm. longae, subtus minute scaberulae, vaginis plerumque duplo longiores, summa basin paniculae amplectans; ligula lanceolata, 4-6 mm. longa; panicula diffusa, 8-20 cm. longa, ramis capillaribus, verticillatis, divisis, scaberulis, pedicellis, 3-6 mm. longis, distantibus; glumae exteriores inaequales, acutae, divergentes, secus carinam scaberulae, prima 3 mm. longa, secunda 2½ mm. longa; gluma florens 1¾ mm. longa, glabra, truncata, apice denticulata, 4-5-nervis, mutica; palea paululo brevior; rhachilla in setam glabram vel parce pilosam dimidio vel minus quam palea breviorem producta, ceteroqui nuda; caryopsis conico-oblonga, 1½ mm. longa.

Near Riverton, March, 1931. According to the collector, Mr. Worsley Johnston, it grows in tussocks inside the railway fence. This might suggest an introduced alien, but the railway reserves also serve as sanctuaries for native plants.

Although this species has the rhachilla produced in a small bristle behind the palea, it seems, from the absence of hairs at the base of the flowering glume, to be better placed in *Agrostis* than in *Calamagrostis*. It differs from *C. aequata* in the following characters: stiff stems and involute, not flat leaves, outer glumes about twice as long and much longer than the flowering glume, which has no tuft of hairs at its base. From the Mediterranean *Agrostis maritima*, Lamk. it differs in the long loose panicle, longer pedicels, palea scarcely shorter than the flowering glume and the bristle at its back. (Fig. 5.)

**Schismus barbatus* (L.) Juel, Hort. Linn. 13 (1913) instead of *S. calycinus* (Loefl.) Coss. et Dur. The name *Festuca barbata*, L. (1756) is two years earlier than that of Loefling.

**Sphenopus divaricatus.* Bute; previously recorded from Port Adelaide.

Eragrostis Brownii, Nees. William Creek and Irrapatana (Far North); coll. J. B. Cleland. These northern specimens have the spikelets at first green or purplish, finally straw-coloured, 5-10 mm. long by 2 mm. broad, 10-20-flowered, rarely more. They resemble *E. setifolia*, but the spikelets are sessile or almost so, and the base of the stem is neither bulbous nor woolly.

Deschampsia caespitosa (L.) Beauv. var. *macrantha*, Hackel. On wet rocks beside waterfall on Upper Hindmarsh River; coll. J. B. Cleland. Hitherto only recorded (in South Australia) from the South-East. Differs from the typical European form by the involute-subulate, not flat leaves, and by the longer outer glumes—4½-5 mm. instead of 3 mm. long. These characters seem to occur also in the East-Australian and New Zealand plant, and justify the varietal name which Cheeseman states was given to it by Hackel.

In the Fl. Cap. 7: 587 (1900) Dr. Stapf says that *Sporobolus elongatus*, R. Br. (*S. indicus*, R. Br. var. *elongatus*, Bailey) is a diandrous species distinct from *S. indicus* and extending from Australia to Japan. In a specimen from the Finke River, C.A., with panicles to 25 cm. long and much interrupted, I found, however, out of 14 spikelets examined, 10 flowers with 3 stamens, 2 with 2 stamens, and 2 with 1 stamen each.

**Ehrharta calycina*, Sm. Established on light sandy land at Cockatoo Valley, Barossa Goldfields; Aug., 1931; per A. J. Warren, Department of Agriculture. Native of South Africa. Like all *Ehrhartas*, a good fodder grass.

Cyperaceae.

Cladium Gunnii, Hook. f. was found in 1930 by Prof. J. B. Cleland at Cleland's Gully, Square Waterhole.

Schoenus tesquorum, J. M. Black. Back Valley, near Encounter Bay; coll J. B. Cleland. Hitherto only recorded from the South-East.

Chenopodiaceae.

Atriplex crassipes, J. M. Black (1918). Mr. R. H. Anderson, in Proc. Linn. Soc. N.S.W. 55: 5: 494 (1930) considers that this should be retained as a distinct species, instead of being united to *A. elachophyllum*, F. v. M. (1869). An examination of the type of the latter species shows that there are almost always 3 small protuberances or tooth-like appendages on one or both faces of the fruiting bracteoles. These teeth are lacking in *A. crassipes*. *A. elachophyllum* = *A. varium*, Ewart et Davies (1917) from Central Australia.

A. acutibracteum, R. H. Anderson, l.c. 500. A new species created for the form of *A. leptocarpum* var. *acuminatum*, which I described in Fl. S. Aust. as having "2 small hard dorsal tubercles at the base of the fruiting bracteoles."—Murray Flats; Ooldea; Hughes.

Papaveraceae.

**Roemeria hybrida* (L.) DC. Growing wild near Riverton; coll. Worsley C. Johnston. Mediterranean region. Not hitherto recorded.

Cruciferae.

Cardamine tenuifolia, Hook. Nonning, E.P.; coll. R. H. Pulleine. An entirely new district for this species, hitherto found only in the South-East.

Hutchinsia eremaea, J. M. Black. Wangianna, north of Marree, Aug., 1931, coll. J. B. Cleland. These are much better specimens than those on which the species was founded in these Trans. 47: 369 (1923). Stems ascending, about 25 cm. high; leaves 1½-3 cm. long, including the petiole into which they taper; sepals about 3 mm. long; petals 5-6 mm. long, with a bright yellow, almost orbicular, lamina; stamens 6, with anthers 1½ mm. long; pods from almost orbicular to ovate and sometimes only 5 mm. long; style exserted beyond the pod to a length of 1½ mm.; cotyledons strictly incumbent.

**Sisymbrium Irio,* L. "London Rocket." Near railway station of Owen, Oct., 1931, coll. Worsley C. Johnston. First record for South Australia.

Leguminosae.

Pultenaea quadricolor, n. sp. Fruticulus erectus, gracilis, ramosus, 20-30 cm. altus, ramis pubescentibus; folia alterna, oblanceolata vel superiora lineari-lanceolata, uninervia, 6-14 mm. longa, 1½-2 mm. lata, infra puberula, supra glabra et marginibus incurvis concava, apice in mucronem recurvum desinentia; stipulae subulatae, 2 mm. longae, petiolum brevissimum superantes; flores axillares, solitarii; pedicelli filiformes, 6-7 mm. longi sed foliis breviores; bracteolae herbaceae, lineares, basi duobus lobulis stipuliformibus instructae, sub imo calyce insertae, calycem aequantes vel paulo superantes; calyx 4-5 mm. longus, parce puberulus, lobis lanceolatis tubo paulo longioribus, duobus superioribus breviter coalitis; vexillum calyce duplo longius, flavum, in medio rubrum, alas flavas carinamque coccineam paulo superans; ovarium pubescens, biovulatum; legumen ignotum.

Back Valley, near Encounter Bay; coll. J. B. Cleland, Nov., 1930. The specific name refers to the green of the leaves, the red and yellow of the standard, the yellow of the wings and the crimson of the keel. Section *Coelophyllum.* Differs from *P. elliptica,* Sm. in the broader leaves, flowers all axillary and bracteoles much longer; from *P. villifera,* Sieb. var. *glabrescens* and *P. trinervis* in the fewer and less conspicuous nerves of the leaves and in the flowers on rather long pedicels, not almost sessile. (Fig. 8.)

**Alhagi camelorum,* Fisch. "Camel Thorn." This spiny, deep-rooted perennial was sent from cultivated land near Jamestown to the Agricultural Department. Said to occur also in water-channels at Berri. Recorded from Rutherglen, Victoria, in 1919. Its native country extends from Southern Russia to North-western India.

**Trifolium lappaceum,* L. Echunga.—Mediterranean region.

Zygophyllaceae.

Specimens of *Zygophyllum ammophilum,* from between Coward Springs and Edward Creek, have the capsule only 3 mm. long, with 1 seed in each cell, 4 stamens and petals minute and obovate.

Rutaceae.

Phebalium brachyphyllum, Benth. Sherlock (Pinnaroo railway) and Warooka, Y.P., 1930. This dwarf shrub had remained undetected since the original specimens were collected at Encounter Bay and Coffin Bay over 70 years ago.

Euphorbiaceae.

**Chrozophora tinctoria* (L.) Juss. A weed at Appila. An annual of the Mediterranean region, sometimes cultivated for the blue dye which it yields.

Frankeniaceae.

Frankenia annua, Summerh. in Journ. Linn. Soc. 48: 379, t. 17 (1930) var. *orthotricha,* n. var. Variat pilis patentibus, interdum leviter curvis sed nunquam uncinatis, caulibus pilosioribus et petalis paulo latioribus (4-5 mm. latis).

Diamantina River, S.A., May, 1931; coll. L. Reese.

Umbelliferae.

Eryngium supinum (F. v. M.) n. comb. Caules prostrati, rigidi, costati, fistulati, simplices vel parce ramosi; foliorum laminae flaccidae, cuneatae, complicatae, acute trilobae, 1-2 cm. longae, 3-6 mm. latae, reticulato-nervosae; petiolus 3-6 cm. longus, fistulatus et parce septatus, basi dilatatus; capitula axillaria et radicalia, brevissime pedunculata, adulta oblongo-cylindrata, 12-17 mm. longa, 8 mm. diam.; involucri bracteae 5-8, lineari-lanceolata, 7-8 mm. longa, fere pungentia; petalorum apex inflexus, fimbriatus; receptaculi squamae conico-acuminatae; mericarpium apud commissuram rotundatum; vittae 5, duae commissurales approximatae.—*E. plantagineum,* F. v. M. var. *supinum,* F. v. M. in herb.

S. Aust.—Diamantina River, coll. Dr. Morgan; near Innamincka, coll. R. Cockburn.

Qld.—Wills Creek. Dr. Murray, of Howitt's Expedition.

Differs from *E. rostratum* and *E. plantagineum* in its prostrate habit and very short peduncles; from *E. vesiculosum* in its rigid stems, 3-lobed, not many-toothed leaves, and shorter peduncles, the radical heads being practically sessile. (Fig. 6.)

It has been stated, apparently in all Australian floras (my own of South Australia included), that our species of *Eryngium* have no vittas. All our local species have 5 vittas. The mericarps of Australian *Eryngia* are orbicular in transverse section and have a narrow commissure, so that the two commissural vittas are close together; in European species the mericarp, when cut across, is almost triangular, with a very broad commissure, so that the two commissural vittas are far apart.

**Bupleurum subovatum,* Link (1818) has appeared at the Grange, near Adelaide; a new record.—Mediterranean region. More usually known as *B. protractum,* Hoffmannsegg et Link (1820).

Ericaceae.

**Erica arborea,* L. Roadside, near Aldgate. Flowering Oct., 1931; coll. J. B. Cleland. This is the "White Heath" or "Tree Heath" of gardeners, the "bruyère arborescente" of the French, from whose root "briar pipes" are made. Mediterranean region. Recorded as an escape in Victoria.

Epacridaceae.

Leucopogon collinus (Labill.) R. Br. Bangham Forest Reserve, near Frances; 1930; coll. J. B. Cleland.

BORRAGINACEAE.

Embadium, n. gen.

(From Greek *embadion*, a little slipper, to which the nutlets bear some resemblance.)

Calyx 5-sectus; corolla 5-loba, inappendiculata; stamina 5, inclusa; stylus inter 4 lobos ovarii insertus, stigmate capitato; nuculae 4, suberectae, ovatae vel fere triangulares, superne liberae et stylum multo superantes, dorso margine tumido inflexo crenulato circumdatae, cum parvâ gibbâ oblongâ tumida medianâ semen tegente; nuculae interne convexae, pilis minutis uncinatis conspersae, areolâ medianâ ad gynobasin pyramidalem affixae, ab areolâ usque ad apicem partis seminiferae carinatae. Herba annua; pedicelli fructiferi recurvi.

Embadium stagnense, n. sp. Herba annua, pilis appressis e tuberculis ortis scabrida; caules rigiduli, ascendentes, 5-12 cm. longi, parce ramosa; folia radicalia rosulata, 1-2 cm. longa, longe petiolata, caulina rigidula, sessilia, distantia, oblonga vel lanceolato-ovata, 5-15 mm. longa, in bracteas florales transeuntia; pedicelli fructiferi valde recurvi, 4-8 mm. longi; calycis segmenta lanceolato-ovata, 2 mm. longa, sub fructu patentia; corolla 2½ mm. longa, sine squamis in faucibus, lobis tubo brevioribus; nuculae paululo infra medium parvâ areolâ ad gynobasin affixae.

On recently flooded land at Arcoona, west of Lake Torrens, Sept., 1927; coll. Miss Beatrice Murray. (Fig. 7.) Mr. Ivan M. Johnston, of the Gray Herbarium, Harvard University, and a specialist on *Borraginaceae*, considers that although this little plant approaches *Eritrichium* in the attachment of the nutlets to the receptacle or gynobase, it has other peculiarities which necessitate the creation of a new genus. After examining a specimen which was forwarded to him, he writes:—"The tumid margin combined with the medial crest of the nutlets is unique in the family. Such excessive developments of nutlet margins are usually found in the *Cynoglosseae*. The uncinate pubescence on the fruit is quite characteristic of that tribe also. In fact, I might say that in every *positive* character, except nutlet attachment, it fits into that tribe best, and close to *Omphalodes*. I have, on various occasions stated that I believe that the strict and sole use of nutlet attachments in defining the tribes of the Borages leads to unnaturalness in classification. I am inclined to believe that your plant is a case in point, and that although its technical characters may place it near *Hackelia* and *Eritrichium*, in all probability its nearest relationships are in *Omphalodes*. If this is the case, your plant is a curious Australian development of the *Cynoglosseae* springing from the same immediate stock as has *Omphalodes*, but which, although developing curious marginal structures, has persisted in a primitive attachment of its nutlets."

SCROPHULARIACEAE.

Limosella Curdieana, F. v. M. Beresford (between Marree and Oodnadatta). Flowering and fruiting Aug., 1931; coll. J. B. Cleland. A much more northerly site than any yet recorded.

LABIATAE.

Prostanthera aspalathoides, A. Cunn. Nonning, E.P.; coll. R. H. Pulleine. A new district for this species. Leaves 4-14 mm. long; calyx 12 mm. long, purplish.

**Salvia lanigera*, Poir. (1817). Netherton, near Tailem Bend. An almost woolly weed not hitherto recorded. Southern Italy, Spain, North Africa, Syria. A synonym is *S. controversa*, Ten. (1830).

COMPOSITAE.

Myriocephalus rhizocephalus (DC.) Benth. var. *pluriflorus*, J. M. Black. Beresford (between Marree and Oodnadatta); coll. J. B. Cleland. A more

northerly site than any previously recorded. The uppermost leaves are sometimes no longer than the general involucre.

**Matricaria multiflora* (Thunb.) Fenzl. First record of this rather showy South African annual, which has established itself over a considerable area near Calomba, a railway station about 7 miles north-west of Mallala. It has numerous small bright-yellow homogamous-discoid heads arranged in dense corymbs.

Minuria rigida. Leaves sometimes nearly all opposite, and the plant may be not more than 8 cm. high. Diamantina River, S.A.; coll. A. M. Morgan.

DESCRIPTION OF PLATE VI.

Fig. 1. *Eragrostis japonica:* *a,* spikelet; *b,* flowering glume and palea; *c,* grain.

Fig. 2. *E. confertiflora:* *d,* leaf and ligule; *e,* spikelet; *f,* flowering glume and palea; *g,* grain.

Fig. 3. *E. Kennedyae:* *h,* spikelet; *i,* flowering glume and palea; *j,* grain.

Fig. 4. *E. infecunda:* *k,* spikelet; *l,* pistil; *m,* base of stem.

Fig. 5. *Agrostis limitanea:* *n,* spikelet; *o,* flowering glume and palea; *p,* abaxial face of grain, showing small embryo; *q,* adaxial face, showing longitudinal groove.

Fig. 6. *Eryngium supinum:* *r,* flower; *s,* petal; *t,* cross section of ripe mericarp; *u,* blade of leaf.

Fig. 7. *Embadium stagnense:* *v,* outer or dorsal face of nutlet; *w,* inner or ventral face; *x,* tubercle-seated hair.

Fig. 8. *Pultenaea quadricolor:* *y,* flower; *z,* leaf.

POLLINATION OF CALADENIA DEFORMIS, R. BR.

BY R. S. ROGERS, M.A., M.D., F.L.S.

Summary

It is a singular fact, that although considerable attention has been directed to the pollination of Australian orchids, very few observations have been recorded in regard to the large and conspicuous Caladenia.

By far the most important paper that has yet appeared is that of Oswald H. Sargent [(1)] on the "Pollination of C. Babarossae," Rehb. f., a Western Australian plant, in 1907.

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[Read October 8, 1931.]

It is a singular fact, that although considerable attention has been directed to the pollination of Australian orchids, very few observations have been recorded in regard to the large and conspicuous genus *Caladenia.*

By far the most important paper that has yet appeared is that of Oswald H. Sargent[1] on the "Pollination of *C. Barbarossae,*" Rchb. f., a Western Australian plant, in 1907.

In his great and well-known work,[2] Fitzgerald makes three brief and rather unconvincing contributions to the subject.

In the first of these, when describing *C. dimorpha,* he states: "This is the only species of orchid I have known, when placed in a room, to be fertilized by insects. A house-fly, lighting on the lip, was carried by its spring against the column and, becoming entangled in the gluten of the stigma, and struggling to escape, removed the pollen in its masses from the anther and smeared them on the stigma. Such rather large insects are, I believe, the principal agents of fertilization in the genus, the species of which without such agency, never produce seed."

His next reference is to *C. tesselata,* Fitzg.: "On examination of the plant as it grew, the pollen was found to be drawn out of the anther and attached to the centre of the stigma by a little group of chaffy scales of some plant, which helped to form a cocoon. This cocoon belonged to a dipterous insect, and the flower must have been fertilized by the efforts of the inmate to get rid of its covering. A method of fertilization that may frequently occur, as the dorsal sepal presents a suitable shelter for an insect about to undergo a change, but a method that would hardly be conjectured if not observed."

His third observation is as follows: "On one occasion I had the pleasure of seeing *C. alba* actually fertilized by an insect. A flower was observed to tremble and, on examination, it was found that a fly had alighted upon its labellum, and was by its spring carried against the stigma and, adhering to it, struggled violently to escape, and thereby withdrew the pollen-masses from the anther and smeared them on the stigma. This instance, in my opinion, goes far to show that though the pollinia in this and many other species may, without fertilizing the flower, be easily removed by touching the discs, the operation is not by any means so neatly performed by an entrapped insect, and the consequence is that the flowers are impregnated by their own pollen."

While admitting that pollination may possibly have been effected in the manner described, it is suggested that such instances are of a fortuitous or accidental nature and lack the purposive character which usually marks the act of pollination in orchids under normal conditions. This act is often intricate and, as far as our experience goes, never clumsily performed. The mechanism involved is beautifully adapted for its intended purpose, and wherever successfully investigated has proved to be unencumbered by superfluous or unessential parts. It frequently happens that some minute structural detail, apparently too trivial to claim the attention of the observer, ultimately proved an important factor in the process.

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(1) "Journ. Nat. Hist. Soc. of W.A.," No. 4 (1907), p. 6.

(2) "Australian Orchids."

More or less complicated structures are present in the three species of orchid to which Fitzgerald refers. That they perform some definite function in the normal pollination of the plant there can be no doubt—a function which remains unexplained and valueless in the instances recorded by him.

The patient and careful observations of Sargent form a much more valuable contribution to the literature of the subject. They are confined to the investigation of a single species endemic to his State, and they extended over a period of two or three years. He furnishes satisfactory evidence that this orchid, which is remarkably distinctive in structure, is pollinated by an unidentified wasp. Whether this is the sole agent is, of course, uncertain.

Mrs. Edith Coleman (3) recently reported that on two occasions she had seen this particular orchid visited by a small bee resembling *Halictus*, sp. No pollen was removed on either occasion, but the movements of the insect led her to suspect that it might be an active agent in the fertilization of the plant.

Early in August, of the present year, Mr. Harold Goldsack, of Coromandel Valley, informed me that he had seen a small native bee crawling on the labellum of *Caladenia deformis*, an orchid well represented in this locality. As the bee had several pollinia adhering to its back, he collected it, as well as the plant, and took them home for further observation. The following morning, on opening the box in which it was confined, he found the insect wedged tightly in the tubular space formed between the column and labellum of the orchid. When disturbed it hurriedly backed out on to the free extremity of the lip. During this movement the pollinia were rubbed hard against the stigma, but no further masses were removed from the anther. Later it returned to "its repast," and it was possible to follow its subsequent movements more carefully. It was able, without any exertion, to penetrate the space referred to, until a point was reached when the mesothorax was on a level with the stigma. Then, in its effort to reach the calli at the base of the labellum, it pushed the latter away from the column, at the same time exerting strong pressure with its back against this structure and incidentally pressing the pollen on to the stigma. This movement enabled it to lever the labellum further outwards, and so penetrate a little lower into the tube. The calli were then apparently seized with its fore-legs and the tongue of the insect was protruded, but further observations were, unfortunately, prevented owing to the structure of the flower.

The bee was dead when the specimens reached me by post, the wings were raised and more or less parallel to each other. On the dorsum of the thorax, lying nearly transversely across the insertions of the wings, were two pollinia, and probably a portion of a third. Examination of the anther of the flower showed that the cells were intact and still contained their normal complement of pollen-masses, two in each cell. The stigma was thoroughly dusted with pollen, and an almost entire pollinium was adherent to it. The condition of the anther made it manifest that the masses attached to the insect were derived from another flower. Towards the close of August we made an inspection of many of these plants in the National Park. The day was dull and cloudy, and although not very cold was unfavourable for our investigation. I discovered a specimen of the bee in question crawling up the ovary of a flower. The flower was collected and the subsequent movements of the insect watched. As in the case of Mr. Goldsack's bee, it carried two pollen lamellae attached exactly in the same manner to the dorsum of its thorax. It crawled on to the recurved tip of the labellum and then on to the dense, shaggy calli, where it found a firm footing. It purposively pursued its way into the tube formed by the column and labellum, with its back to the former. It was able to enter this space without coming into contact with the anther or

(3) "Vict. Nat.," xlvi., 1930, p. 204.

pollinia, and penetrated the space deeply until only the tip of its abdomen was visible at the orifice. It then exerted hard and persistent pressure with its feet against the labellum, as though endeavouring to push the latter away from it. The results of this pressure were plainly visible to us in the movements of the labellum causing a widening of the "space" and pressure of the thorax of the insect against the stigma. It was not possible to observe exactly what took place at the base of the column. After a short interval the insect emerged by backing out, and was captured. It still had a couple of pollen lamellae attached to its thorax, but apparently not the same ones, as two masses had been removed from the anther of the flower and pollinia had been successfully deposited on the stigma.

A little later in the day my wife discovered another bee with pollinia adherent as in previous cases. Unfortunately, a capture was not effected in this instance.

On September 2 my wife and I again visited the Park. The day was again unsuitable for our quest, rather cold and rain threatening. Only a single *Halictus* was seen, towards the close of the afternoon. Lamellae were adherent in the usual manner. As the light was beginning to fade, the insect was captured and placed in a container with the flower on which it was found. The following morning it was found *within* the flower. It liberated itself as previous bees had done, but emerged without pollinia on its body. Again the flower was pollinated, but the contents of the anther were intact. Possibly the flower was no longer fresh and, in consequence, removal of the masses had not been accomplished.

Another flower, stripped of its perianth, was introduced into the bottle, but a successful entry was not made.

Caladenia deformis is a very common orchid and is distributed throughout the entire breadth of Southern Australia. It also extends north along the east coast as far as latitude 33°.

It this State it is the first *Caladenia* to appear during the season. A few isolated specimens may be seen during the last few days of July, but it becomes fairly prolific during the early part of August.

The flowers are solitary, deep blue in colour, but occasionally an albino may be seen. The segments of the perianth are spreading, with the exception of the dorsal sepal which is usually more or less hoodlike behind the column. The labellum is not attached by the usual mobile claw, but is rather rigidly erect against the column, the sides of which it clasps, thus forming a tube; the apical part is triangular with fimbriated or dentate margins, and recurved so that its tip is in contact with the anterior surface of the vertical portion, thus facilitating access of the pollinating agent to the tube. Except for a small nude glandular area at the extreme tip, the recurved portion is covered with dense, shaggy calli arranged in six rows; behind these and within the mouth of the tube the calli are smaller, less crowded and reduced to four rows, while towards the base of the lamina there is an area of densely packed, large, colourless, glandular-looking calli covered with stellate hairs. When the labellum is in its normal position these large calli are in close contact with the anterior surface of the lower half of the column, thus preventing further ingress of an insect, unless force is exerted by the latter to displace the labellum outwards. These basal calli are apparently the tissues sought by the bee, and it is during its efforts to reach them that its thorax is pressed against the stigma and pollination is thus effected.

The column is about 1·3 cm. long, erect in its lower part and rather abruptly incurved near the apex. It is winged throughout, the wings being much wider on either side of the stigma, thus limiting lateral movement of the agent and ensuring direct contact with the stigmatic surface. It is blue or purplish in tint with darker dots or transverse markings, especially on the wings.

The anther is attached almost horizontally to the summit, its mucrone being rather long and acute. It is bilocular, each cell being subdivided by a vertical dissepiment and containing a pair of free pollinia. Each pollinium consists of a flat, rather bluntly falcate lamella composed of dry, mealy pollen. It is wider at the base than at the apex, and has a convex anterior margin. As the anther matures, its valves slightly retract by curling backwards, thus exposing the convex margins of the pollinia a little above the rudimentary rostellum, the surface of which is *very viscid*. The pollinia are devoid of caudicles and viscid disc.

Immediately below the anther is the funnel-shaped stigma, which like the rostellum is extremely viscid. The pollinia are easily withdrawn when any of this sticky material is brought in contact with their exposed edges.

No nectar is secreted by the flower. The base of the labellum and its adjacent parts are quite dry, and no injury to any of these parts can be detected after the act of pollination. The actual source of attraction to the insect is not apparent. It is noticeable, however, that a positive glucose reaction is yielded by the column and to a lesser extent by the labellum.

The bee was subsequently identified as *Halictus subinclinans*, Ckll., by Mr. Tarlton Rayment, the well-known expert in this group. It is smaller than a house-fly and is admirably adapted, both in shape and size, to perform the service which it renders to this particular *Caladenia*.

In his letter to our Museum staff, Mr. Rayment briefly outlines its life-history, which is of extreme interest and forms one of the romances of science.

Inter alia he states that the first females emerge early in August, but he has never been able to secure any males. He has reason to suppose that the males only appear in the late autumn.

Their homes are in well-drained sandy banks, the shafts have a diameter of two or three millimetres and go down almost vertically.

PELECYPODA FROM THE ABATTOIRS BORE, INCLUDING TWELVE NEW SPECIES

BY NELLY HOOPER WOODS, M.A.

Summary

The shells of which those cited in this paper farm a part were collected by Sir Joseph Verco after the sinking of the Abattoirs Bore in 1919. Unfortunately, the material had been heaped beside the bore before any opportunity could be gained of ascertaining the depth from which the various fossils were obtained. It is impossible, therefore, to assign new species to any definite horizon; one can only remark that the fossils were taken from a depth between 400 and 500 feet, and are probably of Janjukian to Werrikooian age.

PELECYPODA FROM THE ABATTOIRS BORE, INCLUDING TWELVE NEW SPECIES.

By Nelly Hooper Woods, M.A.

[Read October 8, 1931.]

Plates VII. and VIII.

Introduction.

The shells of which those cited in this paper form a part were collected by Sir Joseph Verco after the sinking of the Abattoirs Bore in 1919. Unfortunately, the material had been heaped beside the bore before any opportunity could be gained of ascertaining the depth from which the various fossils were obtained. It is impossible, therefore, to assign new species to any definite horizon; one can only remark that the fossils were taken from a depth between 400 and 500 feet, and are probably of Janjukian to Werrikooian age.

It has been interesting to compare many of the fossil species with the recent shells, and to observe in some cases gradations between the fossil and the recent. This is so in the case of *Nuculana crebrecostata* T. Woods and *Nuculana verconis* Verco; specimens intermediate between the two were found. In the case of *Limopsis beaumariensis* Chapman, the juvenile shells bear a marked resemblance to *Limopsis eucosmus* Verco.

Many thanks are due to Mr. F. Chapman for his assistance with difficult and new species.

Nucula venusta, n. sp.

(Pl. vii., figs. 1 and 2.)

Solid, ventricose, inequilateral, ovate; umbo very prominent, inclined markedly to posterior; posterior margin short, curved evenly from dorsal to ventral border; anterior margin longer than posterior, curving evenly though slightly more sharply from dorsal to ventral border.

Interior of shell smooth, nacreous, ventral margin flattened, without denticulations; surface smooth, shining, with fine concentric growth-lines of varying strength.

Cardinal line with 17 teeth anteriorly, slightly uncinate, and 6 posteriorly; teeth strong, high.

Length, 5·6 mm.; height, 4·8 mm.

Observations.—Unfortunately there are only two right valves of this beautiful little shell, which, though resembling it in some respects, differs markedly from *N. obliqua* Lamarck. The shell is much more tumid, especially in the umbonal region; it is more produced anteriorly, and has fewer teeth. The junction between the anterior and posterior row is worn in both specimens, making it impossible to tell the nature of the resilifer.

Rochefortia macer, n. sp.

(Pl. vii., fig. 3.)

Thin, white, medium, somewhat flattened, inequilateral, posterior side longer than anterior and more sharply produced; anterior margin roundly curving to ventral border; interior of shell smooth, ventral border without denticulations; surface smooth, shining, with fine concentric striae of varying prominence. Hinge

with one strong cardinal tooth inclined posteriorly and one small, more depressed tooth inclined anteriorly.

Length, 11·1 mm.; height, 9·3 mm.

Rochefortia tellinoides, n. sp.

(Pl. vii., fig. 4.)

Small, thin, moderately convex, inequilateral; posterior margin slightly more sharply curving than anterior; umbones small, situated anteriorly. Hinge line without dentition, consisting of two small plates on either side of the umbo, leaving a space beneath the umbo.

Shell longer than high; interior smooth; adductor impressions and pallial line distinct; surface ornamented with fine concentric striae.

Length, 5·7 mm.; height, 3·6 mm.

Dosinia grandis, n. sp.

(Pl. vii., figs. 5 and 6.)

Large, thick, solid, several thick layers being revealed when the shell is broken; area inside pallial line thicker than that outside (this may possibly be due to weathering of specimens); outline of shell indefinite, as the shells have been broken in taking them from the bore; hinge plate very heavy, bearing in the right valve two strong, high cardinal teeth and a deep depression for the insertion of a large tooth of the left valve, and from the umbo to the posterior edge a subtriangular depressed area followed by a triangular area for the ligament and a deep and narrow sulcus; lunule deeply situated; adductor impressions deep and clear. Sculpture consists of numerous thin, fine concentric striae.

Measurements cannot be accurately determined owing to fragmentary nature of specimens, but approximate to:—

Length, 70 mm.; height, 70 mm.

Gafrarium perornatum, n. sp.

(Pl. vii., figs. 7 and 8.)

Medium to small, solid, ovate, longer than high, posterior side produced somewhat; umbones high, acute, situated in front of the middle axis of the shell; both posterior and anterior borders roundly curving to the ventral margin.

Interior smooth, pallial sinus distinct. Surface of shell ornamented with numerous regular radial striae which, on certain umbo-ventral lines, are crossed by short oblique striae making V-shaped patterns, pointing both ventrally and dorsally. Also occasional and varying concentric striae of growth.

Type: Length, 9·6 mm.; height, 7·5 mm.

Larger specimen: Length, 13·5 mm.; height, 10·8 mm.

Antigona pernitida, n. sp.

(Pl. viii., figs. 1 and 2.)

Small to medium, sub-ovate, lengthened anterior-posteriorly; umbones prominent and acute, situated to the anterior side of the central axis; anterior margin roundly curving to the ventral border; posterior margin longer than anterior, curving sharply to ventral edge.

Shell moderately inflated, interior finely crenulate; surface closely ornamented with regular growth lines, the interspaces of which are crossed by fine radial costae.

The type is a small, neat shell which seems to differ from *A. dennanti* Chap. and Crespin in the greater number and prominence of its concentric growth lines, and the greater length of the valve in relation to its height.

A fragment of a larger shell of the same species also came up from the bore, dimensions being about twice those of the type.

Length, 12·3 mm.; height, 9·4 mm.

Pseudoarcopagia detrita, n. sp.

(Pl. vii., fig. 9.)

Small, solid, trigonal, moderately convex, particularly in the umbonal area; anterior side slightly longer and more rounded than posterior.

Interior of shell smooth, ventral border without crenulations; pallial line indistinct owing to the weathering of specimens. In right valve two cardinal teeth, and one lamellar tooth on anterior side—deep socket on posterior; in left valve two cardinal teeth fitting into corresponding sockets of right valve; one large posterior lateral tooth and two anterior laterals fitting into sockets of right valve.

Exterior of shell sculptured with numerous fine radial striae bifurcating towards the ventral border.

Length, 4·8 mm.; height, 4·2 mm.

Diplodonta solitaria, n. sp.

(Pl. viii., fig. 3.)

Holotype—one rather worn specimen only of left valve.

Orbicular, subequilateral, moderately convex; ligament groove long, narrow; umbo subcentral, slightly incurved; lunule lanceolate, slightly sunken. Valve with three cardinal teeth, one bifid; pallial line punctate marked; ventral margin rounded, smooth. Sculpture—fine concentric lines of growth with occasional broader lines.

Length, 22·8 mm.; height, 21·7 mm.

Codakia salebrosa, n. sp.

(Pl. viii., figs. 4 and 5.)

Very thick, rude, interior inside pallial line covered frequently with thick concretions; inequilateral, equivalve, sharply curving on anterior margin, semicircular on posterior side. Ligament pit internal, long, deepening from umbo to top of posterior border; umbones acuminate, teeth embryonic or obsolete. Ventral margin without crenulations. Shell surface very rough with numerous concentric growth lines of varying prominence, crowded near the border.

Length, 27·5 mm.; height, 26·7 mm.

Cryptodon sinuatum, n. sp.

(Pl. viii., Fig. 6.)

Medium to small, thin, triangular-ovate; inequilateral, very swollen, particularly in the dorsal region; umbones prominent, high, placed a little in front of the central axis. Anterior border curved, lower half coming almost at right angles to the ventral margin, posterior part of shell with deep fold. Interior of valve smooth; ventral margin sharp, without crenulations; surface of shell with fine concentric striae of growth in varying prominence.

Holotype: One left valve only. Length, 8·1 mm.; height, 8·2 mm.

Solecurtus subrectangularis, n. sp.

(Pl. viii., Fig. 7.)

Small, thin, inequilateral, posterior side longer and broader than anterior, oblong, very slightly gaping at both ends; posterior side about $\frac{3}{5}$ of the whole length; posterior dorsal line straight, nearly parallel with ventral margin; anterior dorsal margin inclined to horizontal; anterior margin more rounded than

posterior margin, which is nearly vertical. Umbo small. One strong cardinal tooth beneath the umbo; two lateral sockets in front and behind. Pallial line and adductor impressions indistinct.

Surface of shell rudely sculptured with concentric striae of growth crossed by fine bifurcating radial striae; umbonal area showing buff colour, ventral margin white.

Holotype: Left valve. Length, 7·7 mm.; height, 4·6 mm.

Corbula equivalvis, n. sp.

(Pl. viii., figs. 8 and 9.)

Solid, equivalve, inequilateral, ventricose, ovately-triangular, rounded anteriorly, beaked posteriorly, posterior side longer than anterior. Umbones prominent, incurved, especially in right valve; right valve with sharp teeth situated in anterior; left valve with large flattened tooth in posterior side of shell. Surface of shell sculptured with many fine concentric striae, varying in thickness and often discontinuous, particularly in centre of shell, where in one senile specimen a slight furrow is produced; posterior side carinated from umbo to ventral margin; sculpture behind the carina same as rest of shell. Pallial sinus and adductor impressions distinct.

Type: Length, 14·2 mm.; height, 8·4 mm.

Larger specimen: Length, 16·8 mm.; height, 9·3 mm.

LIST OF PELECYPODS OBTAINED FROM THE BORE.

Order PRIONODESMACEA.

Family NUCULIDAE.

Nucula obliqua *Lamarck.*
Nucula morundiana *Tate.*
Nucula venusta *Hooper Woods.*

Family NUCULANIDAE.

Nuculana woodsii *Tenison Woods.*
Nuculana crebrecostata *T. Woods.*
Nuculana verconis *Verco.*

Family PARALLELODONTIDAE.

Cucullaea corioensis *McCoy.*

Family LIMOPSIDAE.

Limopsis beaumariensis *Chapman.*
Limopsis maccoyi *Chapman.*
Limopsis affinitalis *Chapman.*

Family ARCIDAE.

Lissarca rubricata *Tate.*
Arca navicularis *Tate.*
Arca (Barbatia) pistachia *Lamarck.*
Glycimeris convexa *Tate.*
Glycimeris tenuicostata *Reeve.*

Family PTERIIDAE.

Pinctada crassicardia *Tate.*

Family OSTREIDAE.

Ostrea hyotidoidea *Tate.*

Family TRIGONIIDAE.

Neotrigonia acuticostata *McCoy.*

Family PECTINIDAE.

Pecten consobrinus *Tate.*
Chlamys peroni *Tate.*
Chlamys antiaustralis *Tate.*
Amusium hochstetteri *Zittel.*
Hinnites corioensis *McCoy.*

Family SPONDYLIDAE.

Spondylus arenicola *Tate.*

Family LIMIDAE.

Austrolima bassi *T. Woods* (Lima bassi)

Family ANOMIIDAE.

Monia ione *Grey.*

Family MYTILIDAE.

Trichomya hirsuta *Lamarck* (Brachyodontes hirsutus).

Family THRACIIDAE.

Thraciopsis elongata *May.*

Family MYOCHAMIDAE.

Myodora ovata *Reeve.*
Myodora tenuilirata *Tate.*
Myodora corrugata *Tate.*

Family CLAVELLIDAE.

Humphreyia strangei *Adams* and *Angas.*

Family CUSPIDARIIDAE.

Cuspidaria subrostrata *Tate.*

Order TELEODESMACEA.

Family CRASSITELLITIDAE.

Crassitellites oblonga *T. Woods.*
Cuna polita *Tate.*

Family CARDITIDAE.

Cardita compta *Tate.*
Cardita preissi *Minke.*
Venericardia spinulosa *Tate.*
Venericardia pecten *Tate.*
Venericardia subcompacta *Chapman* and *Crespin.*

Family CHAMIDAE.

Chama lamellifera *T. Woods.*

Family LUCINIDAE.

Lucina leucomorpha *Tate.*
Lucina affinis *Tate.*
Lucina projecta *Tate.*
Lucina nuciformis *Tate.*
Lucina fabuloides *Tate.*
Loripes icterica *Reeve.*
Codakia salebrosa *H. Woods.*
Divaricella quadrisulcata *D'Orbigny.*

Family DIPLODONTIDATE.

Diplodonta solitaria *H. Woods.*

Family CRYPTODONTIDAE.

Cryptodon sinuatum *H. Woods.*

Family LEPTONIDAE.

Lepton trigonale *Tate.*
Lepton crassum *Tate.*
Erycina micans *Tate.*
Montacuta sericia *Tate.*
Rochefortia anomala *Angas.*
Rochefortia donaciformis *Angas.*
Rochefortia ovalis *Tate.*
Rochefortia macer *H. Woods.*
Rochefortia tellinoides *H. Woods.*

Family GALEOMMIDAE.

Sportella jubata *Hedley.*

Family CARDIIDAE.

Cardium cygnorum *Deshayes.*
Cardium hemimeris *Tate.*

Family VENERIDAE.

Dosinia johnstoni *Tate.*
Dosinia grandis *H. Woods.*
Gafrarium perornatum *H. Woods.*
Macrocallista submultistriata *Tate.*
Antigona propinqua Tate.
Antigona striatissima *Tate.*
Antigona dimorphylla *Tate.*
Antigona pernitida *H. Woods.*
Clausinella subroborata *Tate.*
Bassina allporti *T. Woods.*
Callanaitis cainozoica *T. Woods.*
Paphia fabagelloides *Tate.*

Family TELLINIDAE.

Psammobia hamiltonensis *Tate.*
Psammobia equalis *Tate.*
Tellina masoni *Tate.*
Pseudoarcopagia detrita *H. Woods.*

Family SEMELIDAE.

Semele vesiculosa *Tate.*

Family SOLENIDAE.

Solecurtus dennanti *Tate.*
Solecurtus subrectangularis *H. Woods.*

Family MACTRIDAE.

Mactra howchiniana *Tate.*
Zenatiopsis angustata *Tate.*

Family CORBULIDAE.

Corbula ephamilla *Tate.*
Corbula equivalvis *H. Woods.*

Family SAXICAVIDAE.

Saxicava australis *Lamarck.*
Saxicava subalata *Gatliff* and *Gabriel.*

EXPLANATION OF PLATES.

Plate VII.

Fig. 1. Nucula venusta, n. sp. X8.
Fig. 2. N. venusta, n. sp. X8.
Fig. 3. Rochefortia macer, n. sp. X4.
Fig. 4. R. tellinoides, n. sp. X8.
Fig. 5. Dosinia grandis (left valve), n. sp. $\frac{2}{3}$ natural size.
Fig. 6. D. grandis (right valve), n. sp. Nearly natural size.
Fig. 7. Gafrarium perornatum, n. sp. X5.
Fig. 8. G. perornatum, n. sp. X5.
Fig. 9. Pseudoarcopagia detrita, n. sp. X9.

Plate VIII.

Fig. 1. Antigona pernitida, n. sp. X4.
Fig. 2. A. pernitida, n. sp. X4.
Fig. 3. Diplodonta solitaria, n. sp. X2.
Fig. 4. Codakia salebrosa, n. sp. $X^3/_2$.
Fig. 5. C. salebrosa, n. sp. $X^3/_2$.
Fig. 6. Cryptodon sinuatum, n. sp. X5.
Fig. 7. Solecurtus subrectangularis, n. sp. X7.
Fig 8. Corbula equivalvis, n. sp. X3.
Fig. 9. C. equivalvis, n. sp. X3.

AUSTRALIAN FUNGI: NOTES AND DESCRIPTION – NO.8

BY J. BURTON CLELAND, M.D.

Summary

The last paper of this series, No. 7, appeared in these Transactions and Proceedings, vol. lii., 1928, pp. 217-222. In the present paper, a number of new species of Agarics and Clavarias are described. Colour tints when specifically noted in capital letters are based, unless otherwise stated, on Ridgway's "Colour Standards and Colour Nomenclature," 1912 edition, references to the plates therein being given.

AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS.—No. 8.

By J. Burton Cleland, M.D.

[Read October 8, 1931.]

The last paper of this series, No. 7, appeared in these Transactions and Proceedings, vol. lii., 1928, pp. 217-222. In the present paper, a number of new species of Agarics and Clavarias are described. Colour tints when specifically noted in capital letters are based, unless otherwise stated, on Ridgway's "Colour Standards and Colour Nomenclature," 1912 edition, references to the plates therein being given.

I am much indebted to Miss E. M. Wakefield, of the Royal Botanic Gardens, Kew, England, for kindly examining a number of specimens and water-colour drawings of Australian Clavarias forwarded to the Director, and for comparing these critically with the world-wide collections there and for expressing opinions on these species. Extracts from her report are appended to the descriptions of the species concerned.

499. *Amanita subalbida*, n. sp.—Pileus $1\frac{3}{4}$ in. (4·4 cm.) in diameter, irregularly convex, then nearly plane with the centre somewhat depressed, mealy with the remains of the universal veil, pallid brownish to nearly white. Gills just adnexed, close, rather narrow, white. Stem 1 in. (2·5 cm.) high, elongating from the bulbous base to $1\frac{3}{4}$ ins. (4·4 cm.), rather short, $\frac{3}{8}$ in. (10 mm.) thick, submealy, nearly equal when expanded, solid, white. Ring superior, when young well marked, membranous, marked above with gill-lines, tending to disappear. Volva disappearing, as a slight friable rim-like edge to the bulb. Spores white, obliquely elliptical, $9·5 \times 5·5\ \mu$. Half-buried in sandy soil. S.A.—Kinchina, June 8, 1925.

500. *Amanita conico-bulbosa*, n. sp.—When young 2 ins. (5 cm.) in diameter, plano-convex with a deep rounded border and edge turned in, slightly viscid when moist, finely villose, greyish white; base of the stem very bulbous ($1\frac{1}{2}$ in., 3·7 cm. thick), the root conical and $2\frac{1}{4}$ ins. (5·6 cm.) deep. When adult, pileus 2 to 4 ins. (5 to 10 cm.) in diameter, slightly convex to a little upturned or convex with the centre depressed, slightly viscid when moist, in places smooth and shining, in others subvillose, with scattered warty patches often villose at the base, or the whole surface dull with no flakes, cuticle peels, white with a slight biscuity tint or chalky white, occasionally with a greyish-brown tint. Gills just reaching the stem, attenuated towards it, close, $\frac{1}{4}$ to $\frac{1}{2}$ in. (6 to 12·5 mm.) deep, ventricose, short ones at the periphery, creamy white, when old with a buffy tint in some lights, when dry brownish. Stem up to 3 to 5 ins. (7·5 to 12·5 cm.) high, $\frac{7}{8}$ in. (2·1 cm.) thick, slightly attenuated upwards, gill-marked above, fibrillose-scaly to matt below, solid, white or whitish, bulb $1\frac{1}{4}$ to $1\frac{1}{2}$ in. (3·1 to 3·7 cm.) thick, root up to 3 ins. (7·5 cm.) long, conical downwards. Ring superior to median, ample, dependant marked with gill-lines above, evanescent. No obvious volva, or volva as a mealy-evanescent rim when young. Flesh white, moderately thick ($\frac{1}{4}$ in., 6 mm., or more), attenuated outwards. Smell sometimes slightly fragrant, when cut somewhat phosphorus-like. Spores elliptical, hyaline, 9 to $11·5 \times 5·5$ to $7\ \mu$. Partly buried in sand or in the ground. S.A.—Kinchina, Beaumont, June, July, August, October.

This species is characterized by being greyish-white when young, later white with a slight biscuity or greyish-brown tint, and by having, usually, scattered villose warty patches, no strong smell and a very long conical root.

501. *Amanitopsis sublutea*, n. sp.—Pileus $1\frac{1}{2}$ to $1\frac{3}{4}$ in. (3·7 to 4·3 cm.) broad, convex, becoming depressed a little in the centre, sticky when moist, pale buff [a little deeper than Warm Buff (xv.)]. Gills just reaching the stem, moderately close, becoming slightly ventricose, white. Stem up to $1\frac{3}{4}$ in. (4·3 cm.) high, $\frac{3}{8}$ in. (10 mm.) thick, equal, mealy above, smooth below, white or a little buff-tinted below, bulb up to $\frac{3}{4}$ in. (19 mm.) thick, spherical, the colour of the pileus, edge just free. Flesh of pileus rather thin, white, attenuated outwards. Spores oblique, 13 to 13·5 × 7 μ. In sand, S.A.—Encounter Bay, August, 1929.

502. *Lepiota fuliginosa*, n. sp.—Pileus up to $\frac{7}{8}$ in. (2·2 cm.) in diameter, slightly convex, then plane or a little upturned, in the centre sooty-brown from minute fibrous scales, almost villose, the scales scantier and paler round the periphery, leaving a pallid, slightly sooty zone $\frac{1}{8}$ in. (3 mm.) or more in diameter. Gills barely free, narrow, close, creamy white. Stem $\frac{1}{8}$ to $\frac{3}{4}$ in. (3 to 19 mm.) high, short, equal, smooth, solid, pallid whitish. Ring distant, as a narrow membranaceous ring, evanescent. Spores oblique with an apiculus, 5·5 × 4·5 μ. On the ground. S.A.—Kinchina, June 8, 1925.

503. *Lepiota nigro-cinerea*, n. sp.—Pileus $\frac{1}{2}$ in. (1·2 cm.) in diameter, convex, subumbonate, dark grey from floccose scales. Gills barely reaching the stem, moderately close, cream-coloured. Stem $\frac{5}{8}$ in. (16 mm.) high, slender, a little fibrillose below, whitish. Ring (?) evanescent. Spores very oblique, sometimes nearly triangular, not thick-walled, 5·5 × 3·5 μ. On the ground. S.A.—Encounter Bay, May 24, 1928.

504. *Lepiota cinnamonea*, n. sp.—Pileus $\frac{1}{2}$ to 1 in. (1·2 to 2·5 cm.) in diameter, at first almost campanulato-convex, then expanding to convex, often more or less broadly umbonate, slightly floccose to flecked with minute scales, Light Pinkish Cinnamon (xxix.) to Cinnamon or near Tawny (xv.), sometimes when dry near Apricot Buff (xiv.). Gills just free or barely reaching the stem, rather close to moderately distant, rather narrow, ventricose, cream. Stem 1 in. (2·5 cm.) high, rarely $1\frac{1}{2}$ in. (3·7 cm.), rather slender (5 mm. thick), slightly attenuated upwards, fibrillose to fibrillose-scaly up to the veil attachment which is superior, stuffed or slightly hollow, paler than the pileus to near Tawny, sometimes Cinnamon Rufous (xiv.). No definite ring. Flesh thin, whitish, in the stem with a cinnamon tint and white in the centre. Spores elliptical, slightly oblique, not thick-walled, 5·5 to 7·5 × 3·7 to 4 μ. S.A.—On the ground in a glade in stringy-bark forest, National Park; in *Pinus radiata* Don. (*P. insignis* Douglas) forest, Mount Burr (S.E.), May, 1931.

505. *Lepiota subcristata*, n. sp.—Pileus 1 to $1\frac{1}{2}$ in. (2·5 to 3·7 cm.), at first conico-convex, then convex to nearly plane, with an obtuse umbo, densely covered with small brown fibrillose scales, darker and closer at the disc. Gills free, moderately close, white. Stem to $1\frac{3}{4}$ in. (4·4 cm.) high, rather slender, stuffed tending to be hollow, shaggy with fibrils up to the veil attachment, smooth above. No definite ring. Spores elliptical, not thick-walled, 5·5 to 3·7 μ. S.A.—In *Pinus radiata* Don. (*P. insignis* Douglas) forest, Mount Burr, May, 1931.

Resembles *L. cristata* (A. and S.) Fr., but differs in the shaggy fibrillose stem without a definite ring. *L. cristata* grew in the same locality.

506. *Lepiota discolorata*, n. sp.—Pileus $1\frac{1}{4}$ to 2 ins. (3 to 5 cm.) in diameter, nearly plane, a little upturned, subumbonate, covered with dense very dark reddish-brown scales, fewer near the periphery, sometimes slightly striate at the periphery. Gills just free, close, white or cream-coloured. Stem $1\frac{1}{4}$ to $2\frac{1}{2}$ ins. (3·1 to 6·2 cm.) high, slender, hollow, white above, pale brownish below or pallid with minute brownish flecks. Ring distant, membranaceous, evanescent. Flesh white stained reddish. Smell strong, radishy. The whole plant when dry Fuscous to Fuscous Black (xlvi). Spores elliptical, oblique, not thick-walled, 5 to 6·5 ×

3·5 μ, sometimes 7·5 to 9 × 4·5 μ. On the ground. S.A.—Mount Lofty; National Park; in *Pinus radiata* Don. (*P. insignis* Douglas) forest, Kalangadoo (S.E.). April to June.

A moderately small species, recognised by the dark reddish-brown scales in the pileus and the discolouration of the whole plant on drying.

507. *Lepiota haemorrhagica*, n. sp.—Pileus ¾ to 1¼ in. (1·8 to 3·1 cm.) in diameter, convex, sometimes irregular, covered with reddish-brown fibrillose scales thicker and darker at the disc. Gills free, close, creamy-coloured turning reddish like a fresh bloodstain when bruised. Stem 2 ins. (5 cm.) high, relatively rather stout, attenuated upwards, slightly hollow, clothed with reddish-brown fibrils even above the distant definite membranous pale to reddish ring. Spores elliptical, slightly oblique, not thick-walled, microscopically slightly tinted, 6 × 3·5 μ. On the ground in *Eucalyptus* forest. S.A.—Mount Burr (S.E.), May, 1931.

508. *Lepiota umbonata*, n. sp.—Pileus ½ in. (1·2 cm.) in diameter, slightly convex with a broad obtuse umbo, pallid whitish with a buffy tint. Gills just free, moderately close, pallid flesh-coloured. Stem 1¼ in. (3·1 cm.) high, slender, flesh-coloured. Ring distant. Whole plant when drying brownish. Spores not thick-walled, 5·5 × 3·5 μ. S.A.—In *Pinus radiata* Don. (*P. insignis* Douglas) forest, Kalangadoo, May.

A small species with a whitish umbonate pileus and slender moderately long stem.

509. *Lepiota albo-fibrillosa*, n. sp.—Pure white. Pileus ⅛ in. (3·5 mm.) in diameter, convex, subumbonate, mealy, dotted with white fibrils continuous with the veil and clothing the stem below the attachment of the veil, no definite ring. Gills free, many short, edges rather thick, white. Stem ⅜ in. (10 mm.) high, slender, base a little swollen. Spores elliptical, 6·2 to 7·5 × 3·75 μ. On the ground, under a rock. S.A.—Mount Lofty, May.

A minute white delicate short-stemmed species with white fibrils on the pileus and clothing the stem without a well-defined ring.

510. *Lepiota bulbosa*, n. sp.—Pileus 1 in. (2·5 cm.), convex, pale earthy brown with scattered villose scales. Gills barely reaching the stem, close, slightly ventricose, creamy white. Stem ¾ in. (18 mm.) with the bulb, slender, under ¼ in. (6 mm.) thick, bulb ½ in. (12·5 mm.) thick, white and striate from the gills above the median fixed definite membranous ring, slightly fibrillose and whitish with a brownish tint below, slightly hollow. Spores elliptical, oblique, not thick-walled, 9·3 to 10·5 × 5·5 to 7 μ. On the ground. S.A.—Inman Valley, September 5, 1925.

511. *Clitocybe straminea*, n. sp.—Pileus 1 to 1½ ins. (2·5 to 3·7 cm.) in diameter, irregularly convex, centre usually depressed, thin, nearly semi-translucent, pilose in the centre, fibrillose peripherally, slightly striate, edge radiately splitting, centre blackish-brown, the remainder smoky yellowish-brown, the smokiness due to fine fibrils. Gills slightly but definitely decurrent, moderately close, straw-coloured to pale egg-yellowish. Stem 1½ to 2 ins. (3·7 to 5 cm.) high, equal, slender, somewhat flexuous, twisted, slightly striate, mealy fibrillose above, less so below, hollow, the colour of the gills. Spores subspherical, 4 to 5 μ. Densely caespitose at the base of stumps. S.A.—Mount Lofty, March, April. The specific name has reference to the straw colour of the gills and stem.

512. *Clitocybe eucalyptorum*, n. sp.—Pileus 6 ins. (15 cm.) or more in diameter, irregularly convex with the edge turned in when young, then expanding, the centre finally more or less depressed, repand, innately fibrillose to subtomentose with occasionally small circular patches of thickened cuticle, the edge slightly sulcate, Drab (xlvi.) when young to browner than Tawny Olive (xxix.). Gills moderately decurrent, moderately close, up to ⅜ in. (10 mm.) deep, attenuated at the periphery, cream-coloured, assuming a slight fleshy tint, becoming yellowish

round the edge when old. Stem 4 ins. (10 cm.) long, stout, up to 1 in. (2·5 cm.) thick, swollen below when young, marked above with lines of the gills, subfibrillose below, pallid with tints as on the pileus, with white mycelium mixed with earth at the base. Shed spores subspherical, pear-shaped, slightly irregular, hyaline, 5·5 to 6·5 × 4·5 μ. On the ground amongst leaves, etc., under *Eucalyptus.* S.A.—National Park, July.

513. *Clitocybe campestris*, n. sp.—Pileus up to 1 in. (2·5 cm.) in diameter, slightly convex, irregular with a depressed centre, slightly shiny, the edge turned in when young, pallid stone colour and slightly mottled, faintly obscured by a minute white pile (near Avellaneous, xl.; Light Buff, xv.). Gills adnate, close, rather thick, rarely forking or with buttresses, pallid brownish white (Avellaneous, xl.; near Vinaceous Buff, xl.). Stem up to ¾ in. (1·8 cm.) high, stout, sometimes flattened, slightly fibrous, tough, hollow, mealy, pallid, or the colour of the pileus. Flesh white. Smell strong. Spores 4·5 to 4·8 × 2·2 to 3·2 μ. In grassy places, Beaumont Common, May, June; Eagle-on-the-Hill, June (Miss Fiveash, Watercolour No. 25); Noarlunga Hill (spores 5·5 × 3·7 μ).

A small species somewhat resembling small specimens of *Hebeloma hiemale* Bres., characterised by its pallid buff pileus with darker tints of avellaneous and wood brown appearing as if under the surface, the avellaneous gills, short stem and occurrence in grassy places.

514. *Clitocybe pascua*, n. sp.—Pileus 1 to 1½ in. (2·5 to 3·7 cm.), rarely 2 ins. (5 cm.) in diameter, irregularly convex, soon becoming depressed in the centre and sometimes infundibuliform, edge often irregular and wavy or slightly lobed, sometimes lacerated, smooth, when moist between Sudan Brown and Brussels Brown (iii.) and semi-translucent, when dry opaque whitish or buffy whitish. Gills slightly decurrent, rather close, moderately narrow, many short, greyer than Pinkish Buff (xxix.). Stem short, ½ to 1 in. (1·2 to 2·5 cm.) high, slender, equal or sometimes attenuated downwards, fibrillose, hollow, brownish when moist, pallid when dry. Flesh watery brownish when moist, whitish when dry. Smell a little strong. Spores obliquely elliptical, 7 × 3·7 μ. Gregarious on grassy hills. S.A.—Near Noarlunga, June 25, 1927.

515. *Clitocybe australiana*, n. sp.—Pileus up to 1¼ to 4 ins. (3·1 to 10 cm.) in diameter, irregular, somewhat convex, centre depressed, edge rather irregular and broken up, dull, smooth, pale biscuit colour (near Pinkish Buff, xxix.), paler than Mikado Brown (xxix.) and near Vinaceous Cinnamon (xxix.), soapy-looking when moist, near Sayal Brown (xxix.) when dry. Gills adnato-decurrent to decurrent, narrow, moderately close, near Pinkish Buff. Stem up to 1½ ins. (3·7 cm.) high, slender to stout, up to ⅝ in. (15 mm.) thick, slightly attenuated downwards, dull surface, solid or slightly hollow, with fluffy mycelium at the base, white. Flesh white, thick over the stem, attenuated outwards. Spores 3·2 to 5·6 × 1·6 to 3·2 μ. Single or two or three together or subcaespitose in sandy soil under trees. S.A.—Kinchina, Monarto South, and Enfield. N.S.W.—Bumberry and Manildra. July, August, September, October.

516. *Collybia subdryophila*, n. sp.—Pileus up to 1¼ in. (3·1 cm.), slightly convex, sometimes eventually a little upturned at the edge, irregular, matt, near Pinkish Buff (xxix.). Gills adnate to adnexed (once apparently sinuate), close, narrow, creamy white. Stem up to 1½ in. (3·7 cm.) high, rather slender, sometimes flattened, sometimes slightly attenuated upwards, smooth or matt, hollow, flesh confluent with but heterogeneous from that of the pileus, reddish-brown (near Verona Brown, xxix.). Shed spores with one end more pointed, 4 to 4·2 × 2 μ. S.A.—Mount Lofty, July, 1921, and April, 1924 (spores 5·6 × 3·75 μ); Mount Compass, October; Kinchina, July (spores 3·2 × 2 μ); near Happy Valley, September; National Park; Hope Valley.

517. *Collybia deusta,* n. sp.—Pileus 2 to 3 ins. (5 to 7·5 cm.) in diameter, irregularly plane to slightly depressed with a trace of umbonation, edge somewhat undulatory, surface matt to subtomentose, smoky brownish to scorched brown. Gills adnato-adnexed with occasionally a decurrent tooth, close, narrow ($\frac{1}{4}$ in. +, 6·5 mm. deep), pallid dingy greyish to pallid dingy buff. Stem $1\frac{1}{2}$ to 2 ins. (3·7 to 5 cm.), rather slender ($\frac{1}{4}$ to $\frac{3}{8}$ in., 6 to 9 mm., thick), fibrillose, tough, solid, base slightly swollen into a knob ending abruptly, dark smoky brown. Flesh of stem cartilaginous differing in texture from the flesh of the pileus, which is white and thin. Spores elliptical, $8 \cdot 5 \times 5 \cdot 2\ \mu$. No obvious smell. S.A.—In sand under *Melaleuca halmaturorum* F. v. M., Inman River, Victor Harbour. May.

518. *Collybia alutacea,* n. sp.—Pileus $\frac{3}{4}$ to $1\frac{1}{2}$ in. (1·8 to 3·7 cm.) in diameter, more or less plane becoming upturned-repand, sometimes subumbonate, smooth, rich salmony-buff and moist-looking, sometimes reddish-brown at the periphery, drying opaque matt and a paler pinkish-buff. Gills adnexed, narrow, close, creamy white. Stem $\frac{3}{4}$ to 1 in. (1·8 to 2·5 cm.) high, rather short, somewhat slender, sometimes flattened, equal, smooth, slightly hollow, pallid with a slight or definite tint of the pileus. Flesh of the stem cartilaginous differing from the thin white flesh of the pileus which is attenuated outwards. On the ground. S.A.—Back Valley, off Inman Valley. May, 1929.

Characterised by the rich salmony-buff pileus becoming pinkish-buff, contrasting with the close white gills and short pallid stem slightly tinted like the pileus.

519. *Collybia abutyracea,* n. sp.—Pileus up to $4\frac{3}{4}$ ins. (11·8 cm.) in diameter, at first convex with the edge turned in, then expanding, irregular and repand and more or less subumbonate, at first slightly velutinate, finely somewhat shining and subfibrillose, when young pallid or Cream Buff (xxx.) with a smoky brown tinge, then pallid biscuit-coloured, sometimes with a smoky or scorched tinge, sometimes with the umbo approaching Saccardo's Umber (xxxix.). Gills slightly sinuate to adnate, close, rather dingy creamy white, becoming more biscuit-coloured. Stem up to $1\frac{1}{2}$ in. (3·7 cm.) high, rather slender to moderately stout, $\frac{3}{8}$ to $\frac{1}{2}$ in. (10 to 12·5 mm.) thick, coarsely fibrillose, equal, not rooting, tough and cartilaginous but with the flesh not very clearly distinct from that of the pileus, solid, not stuffed, breaking up into tough fibrils, dark smoky brown to pallid brownish, base whitish when young. Spores elliptical, $7 \cdot 5$ to 9×5 to $5 \cdot 5\ \mu$. No special smell. Amongst grass. S.A.—Beaumont Common, Pinnaroo, Belair. June, July, August.

520. *Collybia eucalyptorum,* n. sp.—Pileus $\frac{5}{8}$ to $1\frac{1}{2}$ in. (1·6 to 3·7 cm.) in diameter, broadly conico-campanulate to nearly plane, then slightly upturned, smooth, with the surface dull from innate fibrils, edge slightly striate, Pale Pinkish Buff becoming Cinnamon Buff (xxix), or Ochraceous Buff (xv.) and darker in the centre, becoming pallid towards the periphery. Gills adnexed, close, narrow, with short ones at the periphery, creamy-white or approaching Warm Buff (xv.). Stem 1 to $2\frac{1}{2}$ ins. (2·5 to 6·2 cm.) high, relatively slender ($\frac{1}{8}$ in., 3·5 mm., or more thick), flexuous, smooth or subfibrillose, barely striate, hollow, cartilaginous, differing from the flesh of the pileus, reddish-brown (between Tawny, xv., and Russet, xv.; Mikado Brown, xxix.). Flesh thin, slightly brownish. Smell moderately strong. Spores pear-shaped, hyaline, 5 to $5 \cdot 5 \times 3 \cdot 5\ \mu$. Caespitose at the bases of old trunks of *Eucalyptus* or stumps. S.A.—Mount Lofty Summit, June.

521. *Mycena subgalericulata,* n. sp.—Pileus $\frac{1}{2}$ to 1 in. (1·2 to 2·5 cm.) in diameter, $\frac{1}{3}$ to $\frac{3}{4}$ in. (0·8 to 1·8 cm.) high, conico-campanulate, somewhat expanding, umbonate, dry, smooth, submembranaceous, somewhat striate to the umbo, near Olive Brown (xl.), occasionally paler (Buffy Brown, xl.), sometimes Mummy Brown (xv.), during drying becoming paler from above from Olive Brown to Buffy Brown, when young with a pallid peripheral ring. Gills adnate, sometimes

with a slight decurrent tooth, sometimes connected by veins, whitish, sometimes flesh-tinted or greyish when old. Stem $\frac{3}{4}$ to 2 ins. (1·8 to 5 cm.) high, often curved, smooth, polished, somewhat fragile to rather tough, base somewhat strigose, whitish to pallid, sometimes brownish especially below. Shed spores elliptical, oblique, 9 to 13 × 5·5 to 8·5 μ. No cystidia seen. No smell. Caespitose on trunks. S.A.—Mount Lofty (on trunks of *Eucalyptus obliqua* L'Hérit.), National Park. April, June, July, August.

This is evidently a variable species. It differs from Rea's description of *Mycena galericulata* (Scop.) Fr. in being of smaller size, with the cap apparently darker, the gills sometimes becoming greyish when old, and in the stem often being nearly pure white.

The characteristics of the species are the caespitose habit on trunks or stumps, the dark fuscous brown to pale smoky brown umbonate pileus, the gills adnate sometimes with a decurrent tooth and whitish becoming flesh-coloured or greyish, and in the whitish or pallid stem sometimes brownish below.

522. *Mycena australiana*, n. sp.—Pileus $\frac{1}{2}$ in. (1·2 cm.) high, $\frac{3}{4}$ in. (1·8 cm.) broad, broadly conico-campanulate, slightly striate, Buffy Brown to Clove Brown (xl.) or Wood Brown (xl.), apex darker. Gills adnate, with no decurrent tooth, moderately close, pure white becoming creamy. Stem about 3·7 cm. high, slender, polished, a little mealy at the base but without strigose hairs, apex whitish, Buffy Brown towards the base. Spores 8·5 to 11 × 6 to 7·5 μ. Gregarious or caespitose on fallen log. S.A.—National Park, Mount Lofty. May, June, July.

523. *Mycena vinacea*, n. sp.—Pileus $\frac{3}{4}$ to $1\frac{1}{2}$ in. (1·8 to 3·7 cm.) in diameter, conico-hemispherical or broadly conical to convex, then expanded, sometimes with an acute or obtuse umbo, matt or smooth, slightly shining, striate at the periphery when moist, edge slightly incurved when young, Pale Vinaceous Drab to Vinaceous Drab (xlv.), Light Cinnamon Drab (xlvi.), near Sorghum Brown (xxxix.) or yellower than Vinaceous Brown (xl.), sometimes Fuscous (xlvi.) when old, drying to near Pinkish Buff (xxix.), paler than Avellaneous (xl.) or between Avellaneous and Olive Buff (xl.). Gills adnate or slightly sinuate with a decurrent tooth, moderately close, ventricose, many short, edges tending to be frayed, Pale Vinaceous Drab, Pale Brownish Drab (xlv.), Pale Greyish Vinaceous, or Vinaceous Fawn to Fawn Colour (xl.). Stem 1 to $2\frac{3}{4}$ ins. (2·5 to 6·8 cm.) high, slender to a little stout, equal or slightly attenuated upwards or downwards, smooth, hollow, base pallid and tending to be villose, Dark Vinaceous Drab (xlv.) when young, Light Greyish Vinaceous (xxxix.), near pale Brownish Drab or Wood Brown (xl.). The pallid brownish flesh of the cartilaginous stem heterogeneous from the white flesh of the pileus. Spores obliquely elliptical, 7·5 to 13 × 4 to 8·5 μ. Caespitose or subcaespitose on fallen wood on the ground, at the base of stumps, or amongst fallen leaves and grass or pine needles. S.A.—Mount Lofty, National Park, Baker's Gully near Clarendon, Kuitpo, Kinchina, Kalangadoo (under *Pinus)*, Caroline State Forest (near Mount Gambier—under *Pinus)*. N.S.W.—Cambewarra Mount. May, June, July, August.

Readily recognised by the lilacy or vinaceous tint of the whole plant and the caespitose habit.

524. *Mycena subalbida*, n. sp.—Pileus up to $\frac{1}{4}$ in. (6·2 mm.) in diameter, usually less, conico-campanulate to convex, sometimes dimpled, sometimes gibbous or umbonate, ribbed, mealy or scurfy to glabrous, white with a greyish-brown or creamy tint. Gills adnate, attached to a collar, ascending, slightly ventricose, rather narrow, about 12 to 14 in number with shorter ones interposed, pallid greyish white. Stem $^{3}/_{16}$ to $\frac{3}{8}$ in. (4·5 to 10 mm.) high, curved, very slender, mealy to smooth, white to pallid, sometimes slightly brownish below, attached by a minute slightly strigose disc. Spores subspherical, 9 to 11 μ, 10 × 8·4 μ; the

cells on the edges of the gills bristling with minute processes; cystidia, 25 μ long, with tapering apices and ventricose bases seen in one batch of specimens. S.A.—On mossy bark of elms (*Ulmus campestris* L.), North Terrace, Adelaide, June, July; on bark of *Schinas Molle* L., Fullarton, July; on trunk, National Park (spores $9{\cdot}5 \times 6{\cdot}5\ \mu$).

The species seems to be related to *M. corticola* Fr. and *M. hiemalis* (Osb.) Fr., but differs and belongs to the section Basipedes by having a definite though small disc. We cannot find a description to fit it.

525. *Leptonia fusca*, n. sp.—Pileus $\frac{3}{4}$ to $1\frac{1}{8}$ in. (1·8 to 2·8 cm.) in diameter, slightly convex, umbilicate, radiately fibrillose, between Natal Brown and Bone Brown (xl.). Gills sinuately adnexed, moderately close, edges not dark, near Vinaceous Buff (xl.). Stem $1\frac{1}{4}$ in. (3·1 cm.) high, slender, sometimes flattened, polished, brittle, hollow, cartilaginous, near Dusky Drab (xlv.), base whitish. Flesh very thin. Spores angular, tinted, 11 to $13 \times 7{\cdot}5\ \mu$. On the ground. S.A.—Encounter Bay, May 24, 1931.

Characterised by the dark dusky brown pileus and stem, whitish base to the stem, vinaceous buff gills and rather large angular spores.

526. *Clitopilus prostratus*, n. sp.—Pileus $\frac{3}{4}$ to 1 in. (1·8 to 2·5 cm.) in diameter, very irregular, more or less convex with the centre depressed, somewhat rugose, somewhat fibrillose, edge sometimes crinkled, colour of dead grass. Gills decurrent, moderately close, relatively deep, pallid salmon-colourd. Stem short (1 cm.), central to excentric, slender, surface matt, whitish. Spores angular with a central yellowish gutta, tinted, 9·5 to $10{\cdot}5 \times 7{\cdot}5\ \mu$. Nearly prostrate on bare sandy soil in heathy scrub. S.A.—Near Mount Burr (S.E.). May, 1931.

527. *Clitopilus subfrumentaceus*, n. sp.—Pileus $1\frac{1}{4}$ to 4 ins. (3 to 10 cm.) in diameter, irregularly convex, then more expanded or with the centre depressed, often distorted, sometimes with a small umbo, subfibrillose, edge turned in when young, not shining, somewhat hygrophanous, Pinkish Cinnamon, Cinnamon, Sayal Brown, or Mikado Brown (xxix.) becoming paler. Gills adnate to adnate-decurrent, narrow, moderately close, edges sometimes irregularly serrate, rarely forking or anastomosing near the stem to form long narrow cells, Light Pinkish Cinnamon (xxix.). Stem $1\frac{1}{2}$ to $2\frac{1}{2}$ ins. (3·7 to 6·2 cm.) high, stout (up to $\frac{7}{8}$ in., 2·2 cm. thick), base swollen (1 in., 2·5 cm. thick), sometimes a little excentric, somewhat mealy or fibrillose, solid, pale fawny or biscuity whitish or white. Flesh watery semi-translucent becoming whitish. Slight smell of radishes. Spores obliquely pear-shaped, rather irregular, definitely tinted, 6·5 to $8{\cdot}5 \times 4{\cdot}2$ to 6 μ. Densely caespitose under trees or amongst grass. S.A.—Mount Lofty Range, National Park. Vict.—Ararat. April to August.

The specific name has reference to its resemblance to *Entoloma frumentaceum* (Bull.) Berk.

528. *Clavaria vinaceo-cervina*, n. sp.—Plants $\frac{1}{2}$ to 2 ins. (1·2 to 5 cm.) high, nearly vertical or slightly spreading, from a short stem-like base very irregularly branching, sometimes with only a few branches or prong-like divisions, sometimes with a number of small branches, ultimate divisions short, prong-like, mostly blunt, sometimes acute and thorn-like, sometimes awl-like or finger-like, often fastigiate, the branches often irregularly flattened and the whole plant rugose, usually relatively slender but in some collections stouter and more knobby, Vinaceous Fawn (xl.) to Fawn Color (xl.), near a pale Vinaceous Russet (xxviii.), deeper than Vinaceous Buff (xl.), between Vinaceous Buff and Avellaneous (xl.), Vinaceous Pink (xxviii.) at the tips with the stem Vinaceous Fawn (xl.), greyer than Buff Pink (xxviii.), or Pinkish Cinnamon (xxix.) with a fine bloom giving a vinaceous pink colour tinge on the pinkish cinnamon, base of stem pallid. Spores subspherical 7·5 to 9 μ, $8 \times 6{\cdot}5\ \mu$, 9 to 10×8 to 8·8 μ. On the ground under

trees amongst shrubs. S.A.—Stirling West, July 23, 1927; Mount Lofty, April, June (Kew No. 86), July; Belair, July; Clare, August.

Specimens of this species (Kew, No. 86) were sent to Miss E. M. Wakefield, who reported: "Probably new. Not European or American."

529. *Clavaria australiana*, n. sp.—Densely branched, up to 4 ins. (10 cm.) high and 5 ins. (12·5 cm.) broad, the branches between Vinaceous Buff (xl.) and Avellaneous (xl.), their tips near Vinaceous Fawn and Fawn (xl.). Contracting uniformly from above to a broad conical base of several stout compacted stems. The thick main branches spread somewhat and divide rather sparingly and very irregularly till the last $\frac{3}{4}$ in. is reached. Here they divide frequently into numerous blunt irregular prongs, often at wide angles, the prongs often divided again and flattened. The stout main branches and the branchlets are definitely rugose. Spore mass slightly but definitely coloured. Spores microscopically slightly coloured, elongated, oblique, mummy-shaped, not striate, 13 to 16 $\times$ 4·5 to 5·5 μ. S.A.—On the ground, Mount Lofty, July, 1927.

530. *Clavaria corallino-rosacea*, n. sp.—Clubs simple, occasionally forked several times, up to $1\frac{1}{2}$ to $2\frac{1}{4}$ ins. (4 to 5·6 cm.) high, prongs when present up to 1 cm. long, slender, attenuated downwards and also sometimes upwards, sometimes rather flattened and grooved, solid, coral red or rosy pink (when moist a little pinker than Morocco Red, Dauthenay, Pl. 95, Ton. 1; when drying shades of Coral Red, Pale Scarlet, Salmon Pink, Pl. 76), often pruinose above, when buried under leaves base whitish. Flesh light coral red. Spores somewhat pear-shaped, 6 $\times$ 3·4 to 4 μ. On the ground, sometimes under *Lantana*. N.S.W.—Mosman (Kew, No. 81; D.I.C., Water-colour No. 54) and Neutral Bay, Sydney, April and June.

Miss E. M. Wakefield, in reporting on No. 81, says:—"Probably the same as the Brisbane specimen (Bailey 241) on which the Australian record of *C. miltina* was founded. The true *miltina* from South America is stouter and has no distinct stem. Unfortunately, the type shows no spores, but it seems unlikely that the Australian species would be the same."

531. *Clavaria complana*, n. sp.—Forming a mass 3 ins. (7·5 cm.) high and 5 ins. (12·5 cm.) broad. From the solid base dividing repeatedly into slender branches which then become flattened and expanded, and then again divide into slender digitate processes $\frac{1}{4}$ in. (6 mm.) long, pale pinkish tussore, becoming brownish salmon, when damp staining paper pinkish salmon. Spores hyaline, subspherical, 5·2 to occasionally 7 μ. N.S.W.—Sydney suburb, probably Hornsby, June 13, 1916 (Kew, No. 68).

Miss Wakefield reported as follows:—"The habit is like that of *C. flabellata* Wakef. from New Caledonia, but the colour is different and the spores larger. It differs from most of the other large branched forms in its hyaline spores."

532. *Clavaria sinapicolor*, n. sp.—Densely branched forming masses up to $2\frac{1}{4} \times 2\frac{1}{4}$ ins. and 3 $\times$ 3 ins. (5·6 $\times$ 5·6 cm. and 7·5 $\times$ 7·5 cm.), near Mustard Yellow (xvi.) or yellower, Straw Yellow (xvi.) and Colonial Buff (xxx.), Naples Yellow (xvi.) or dingier, or Light Orange Yellow (iii.), when old near Chamois (xxx.) but yellower towards the tips or near Cinnamon Buff (xxix.), the bases of the branches paler, the stem whitish. The main branches are compacted into a broad mass at the base up to $1\frac{1}{4}$ in. (3·1 cm.) thick. Dividing upwards repeatedly by very narrow angles into closely pressed nearly vertical more or less rounded rather slender slightly rugose branches, at first $\frac{1}{4}$ in. (6·5 mm.), then $\frac{1}{8}$ in. (3·2 mm.) and then less in diameter, the last $\frac{1}{4}$ to $\frac{1}{2}$ in. ending usually in numerous rather blunt prongs, some very short, often with wider angles between them than in the branches. Spore mass slightly but distinctly buff-tinted or old gold. Spores obliquely pear-shaped to elliptical, slightly tinted microscopically, 5·5 to 8 occasionally 10·4 $\times$ 3·8 to 4·5, occasionally 5 μ. On the ground, usually

in Eucalyptus *(e.g., E. obliqua)* forests. S.A.—Mount Lofty (Kew, Nos. 65, 75, 76), Kuitpo, National Park. N.S.W.—National Park (Kew, No. 66, Miss Clarke, Water-colour No. 126), Kendall, Milson Island in Hawkesbury River (smaller, Kew, No. 67). May to August.

Five collections, as above, were submitted to Miss E. M. Wakefield at Kew, who reported as follows:—"Nos. 65 and 66 are apparently the same as No. 75 and 76. The species is not British or North American. There is no specimen of *C. Kalchbrenneri* Müller at Kew, and the meagre description does not fit it very well. It would probably be better described as new. One of Cooke's determinations of '*C. coralloides,*' from Ovens River, seems to be the same species. No. 67 has spores similar to the last, but appears to have been a smaller and less branched plant. The material is insufficient to enable me to judge as to habit."

533. *Clavaria ochraceo-salmonicolor,* n. sp.—Compact, cauliflower-like $1\frac{3}{4}$ to $3\frac{1}{2}$ ins. (4·4 to 8·7 cm.), usually about $2\frac{1}{2}$ ins. (6·2 cm.) high, 2 to 3 ins. (5 to 7·5 cm.) broad in larger specimens. From a thick pallid base up to 1 in. (2·5 cm.) wide, dividing into stout branches (up to $\frac{3}{8}$ in., 10 mm. thick) and these again dividing three or four times to end in blunt prong-like processes capped by several blunt teeth a few mm. long, angles rather rounded, branches with longitudinal rugae. Colour Light Ochraceous Salmon (xv.), Ochraceous Salmon (xv.), Light Ochraceous Buff (xv.), or Apricot Buff (xv.) when drying; when young Capuchin Orange (iii.), the tips yellower, which yellow may be lost when older; tips sometimes Warm Buff (xv.) or Ochraceous Buff (xv.). Spores elongated pear-shaped with an oblique apiculus, in the mass yellowish-brown, microscopically slightly tinted, 8·5 to 13 $\times$ 3·7 to 5 μ, usually about 9 to 10 $\times$ 4 μ. S.A.—Mount Lofty (Kew, No. 71), Willunga Hill, Second Valley Forest Reserve, MacDonnell B. (in S.E.), April, May, June, July.

Specimens from Mount Lofty, June 16, 1917, forwarded to Kew, were returned by Miss Wakefield as "not matched at Kew."

NOTES ON SOME SOUTH AUSTRALIAN AND CENTRAL AUSTRALIAN MAMMALS. PART 2

BY H. H. FINLAYSON

Summary

1. Since recording the presence of *Thalacomys lagotis* in the Musgrave Ranges (Trans. Royal Soc. S. Aust., 1930, p. 178)) further specimens have been obtained from localities in the centre, considerably further north.

In August, 1930, Messrs. Hale and Tindale, during the stay of the Adelaide University Anthropological Expedition in the Centre, obtained a male and female from the blacks at Macdonald Downs, about 120 miles north-east of Alice Springs. And again in August of this year, when attached to a similar party, Mr. A. Rau, of the Museum staff, obtained a male at Cockatoo Creek, on the Tanami track, about 150 miles north-west of Alice Springs, in latitude 22O S., approximately.

NOTES ON SOME SOUTH AND CENTRAL AUSTRALIAN MAMMALS.

PART 2.

By H. H. Finlayson.

[Read October 8, 1931.]

1. Since recording the presence of *Thalacomys lagotis* in the Musgrave Ranges (Trans. Royal Soc. S. Aust., 1930, p. 178), further specimens have been obtained from localities in the centre, considerably further north.

In August, 1930, Messrs. Hale and Tindale, during the stay of the Adelaide University Anthropological Expedition in the Centre, obtained a male and female from the blacks at Macdonald Downs, about 120 miles north-east of Alice Springs. And again in August of this year, when attached to a similar party, Mr. A. Rau, of the Museum staff, obtained a male at Cockatoo Creek, on the Tanami track, about 150 miles north-west of Alice Springs, in latitude 22° S., approximately.

All three specimens present the characters of *lagotis*, previously noted in the Opparinna example. The largest male, got at Macdonald Downs (S.A. Museum, M 2930), had the following flesh dimensions:—Head and body, 415; tail, 270; pes, 100; and its skull, which is massive and strongly ridged, has a basal length of 98 and zygomatic breadth of 54. The female, taken at the same place, has:—Head and body, 320; tail, 235; pes, 88; and the skull is smooth and devoid of crests, and has basal length 78 and zygomatic breadth 39. Both specimens are aged and show about the same degree of tooth wear; the sexual differences in size and contours are, therefore, extraordinarily marked. The male skull weighs 34 grammes, and the female 15 grammes.

Mr. L. Glauert, Director of the Western Australian Museum, has recently examined a splendid series of 40 *lagotis*, culled from Western Australian localities and, pending completion of his work, has been good enough to inform me in advance of some of his findings. It would appear that even in comparatively restricted areas the adult size is far from constant and varies sufficiently to embrace all four of the Central specimens I have noted.

Under these circumstances, I withdraw the remark that the Central *lagotis* is a dwarfed form, as being at present insufficiently founded.

2. The disappearance of the short-nosed bandicoot, *Isoodon obesulus*, from the greater part of South Australia is a typical example of a number of similar faunal declines occurring, sometimes over areas almost continental in extent; sometimes, as in this case, in restricted localities, but always without adequate cause being apparent.

Originally widely distributed in this State, and in some parts in great numbers, *Isoodon* remained a common and familiar animal long after the beginnings of settlement, and indeed seems to have received its first serious check not more than 30 years ago. Since then it has dwindled to such an extent that the present generation of settlers has largely forgotten even its name, and when, rarely, one is taken, extraordinary speculations as to its identity are heard. In the last 10 years nearly all specimens obtained at the Museum have come from localities in the South-Eastern district, adjoining Victorian territory, where it is much more common, and Wood Jones' record of one from Blackwood (Mammals of S.A., vol. ii., p. 138) has remained unique for the Adelaide district till quite recently.

The causes usually quoted in explanation of these disappearances are the prevalence of foxes and of feral cats, the occurrence of epidemic diseases, the laying of poison baits, competition with the rapidly breeding rabbit, and the burning off of large areas at frequent intervals, and no doubt all these have played a part. But that these in themselves are inadequate to account for all the observed facts, and that other and more fundamental factors are involved, is shown by the still more mysterious recurrence of "extinct" species from time to time, with no apparent change in ecological conditions.

There are now unmistakable signs that the recovery of *I. obesulus* in the Mount Lofty Range is proceeding apace. During the opossum season of 1930 it was constantly reported as being taken by trappers, and some dozens of pelts were sent into the sale rooms, and during the last few months four specimens have come to hand from localities within 20 miles of Adelaide.

The characters of the local race have been fully stated by Wood Jones *(loc. cit.)*

3. From time to time reports have been received by the writer of a small wallaby or "kangaroo rat," occuring sparsely in spinifex country in several localities in the far northern areas of the State. Descriptions of its appearance and habits were sufficiently precise and consistent to rule out both *Bettongia lesueuri* and *B. penicillata* from its possible identity, and it appeared certain that it was one of the hare wallabies, probably *Lagorchestes hirsutus,* which was obtained by the Elder Expedition towards the north-west boundary of the State.

About a year ago an opportunity occurred of questioning a practised observer who had seen the living animal at close quarters and had handled specimens of it, dead. When confronted with a series of filled skins of *L. conspicillatus leichardti, L. c. typicus, L. hirsutus, Bettongia lesueuri, B. penicillata,* and *Aepyprymnus rufescens,* he was quite emphatic that the spinifex wallaby was not represented.

Finality has now been reached (September 10), on receipt of a skin and skull of the animal, which proves to be *Caloprymnus campestris,* described by Gould in 1843, recorded again by Tate in 1878, and since then a "lost" species.

Externally it is very distinct both from the other Potoroinae and from the Lagorchestines, and its skull characters are, fortunately, so peculiar and pronounced as to remove any element of doubt from the identification.

Field work in the locality of the occurrence will at once be undertaken and, pending its completion, a revision of the characters of the animal is deferred.

PETROGRAPHIC NOTES ON SOME BASIC ROCKS FROM THE MOUNT BARKER AND WOODSIDE DISTRICTS

BY A. R. ALDERMAN, M.SC., F. G. S.

Summary

Basic rocks have been recorded from various localities in the Mount Lofty Ranges in South Australia. (1) The rocks described in this paper occur as follow:-

I. Basic dyke, sections 5267 and 5269, Hundred of Onkaparinga; about two miles east of Woodside.

II. Basic dyke, sections 3828 and 3829, Hundred of Macclesfield; one to two miles north-west of Mount Barker (the hill), and not far from Mount Barker Springs.

III. Basic dyke, sections 4213, 4214, and 4216, Hundred of Onkaparinga; near Mount Barker Junction railway station.

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For brevity these occurrences will be referred to as: I., Woodside; II., Mount Barker Springs; and III., Mount Barker Junction. References to these rocks have been made by Howchin,(2) Benson,(3) and others.

The age of the intruded sediments is somewhat doubtful, owing to their metamorphosed condition, but recent work by Prof. W. Howchin(4) seems to indicate that at Mount Barker Springs and Mount Barker Junction they are Upper Pre-Cambrian (Adelaide Series). The intruded rocks at Woodside may be of the same age or Lower Pre-Cambrian (Barossian).

I. The Woodside rock occurs as a broad basic dyke striking in roughly a north-west direction. When examined in the hand specimen the rock appears dark and holocrystalline. It is of porphyritic habit, felspar crystals, up to 5 mm. in length, being embedded in a dark fine-grained groundmass. Some specimens contain far more felspar phenocrysts than others. The rock analysed, and described first, is of the more felspathic type.

Microscopic Features.—The structure is essentially porphyritic, in which large felspar phenocrysts are embedded in a groundmass consisting mostly of felspar and hornblende.

The *felspar* is a basic labradorite, mostly in oblong forms but occasionally showing square cross-sections. Both albite and pericline twinning is common, Carlsbad twins also being occasionally seen. The felspar crystals contain innumerable inclusions of all sizes, the larger of these generally being amphibole although sphene sometimes occurs in this way, and, of course, the felspar alteration products.

Minute inclusions are extremely numerous and are very often arranged in rows parallel to the sides of the felspar crystals. These inclusions consist of both amphibole and chlorite, the latter evidently being an alteration from the former. The arrangement of these parallel to the crystal faces suggests inclusion of the mother liquors during rapid crystallisation of the felspar. Many of these small

(1) Mawson, D., Rept. A.A.A.S., vol. xviii., 1926, pp. 251-252.

(2) Howchin, W., "Geology of South Australia" (sec. ed.), 1929, pp. 61-62.

(3) Benson, W. N., Trans. Roy. Soc., S. Aust., vol. xxxi., 1909, p. 240.

(4) Howchin, W., Trans. Roy. Soc., S. Aust., vol. liii., 1929, pp. 27-32.

inclusions are arranged with a similar optic orientation. Some of the felspar is somewhat obscured by dusty kaolinitic material.

After the felspar, green *hornblende* is the most important mineral. It does not appear to be primary, but to have recrystallized in fine-grained aggregates. No indication of a uralitic nature is shown. It is pleochroic from light to darker green. The smaller individuals, and a few of the larger, show an alteration to chlorite.

Scapolite is a notable constituent and in ordinary light it resembles the felspar, but is easily distinguished by its higher colours between crossed nicols. Grains of this mineral occur adjacent to the felspars, from which they are apparently derived by alteration.

Grains of *zoisite* are common, and although they are sometimes found in separate individuals they generally occur with an aggregate of kaolinitic matter and felspar showing a distinct poikiloblastic structure. Some small colourless grains in this aggregate are probably albite, suggesting that the felspar has been saussuritized.

The opaque iron ore is *ilmenite,* which shows an alteration to leucoxene.

Sphene is present in dusty grey-brown grains which are occasionally wedge-shaped.

A narrow vein of *secondary quartz* is to be seen in one portion of the section examined.

Chemical Analysis.

	Percentage.		Percentage.
Silica (SiO_2)	47·63	Carbon dioxide (CO_2) ..	Nil
Alumina (Al_2O_3)	21·94	Titanium dioxide (TiO_2) ..	0·77
Ferric oxide (Fe_2O_3)	1·81	Phosphorus pentoxide (P_2O_5)	0·15
Ferrous oxide (FeO)	4·59	Sulphur (S)	0·15
Magnesia (MgO)	5·81	Chromic oxide (Cr_2O_3) ..	Trace
Lime (CaO)	14·08	Manganous oxide (MnO) ..	0·08
Soda (Na_2O)	1·79	Barium oxide (BaO)	Nil
Potash (K_2O)	0·28		
Water (combined) (H_2O+)	0·68	Total	99·79
Water (hygroscopic) (H_2O-)	0·03		

The specific gravity is 2·95.

The Norm.

	Percentage.		
Orthoclase	1·67	F = 67·74	Salic Group = 67·74%
Albite	15·20		
Anorthite	50·87		
Diopside	14·52	P = 24·16	Femic Group = 31·26%
Hypersthene	9·64		
Olivine	2·42	O = 2·42	
Ilmenite	1·52	M = 4·07	
Magnetite	2·55		
Apatite	0·34	A = 0·61	
Pyrite	0·27		
Water	0·71		

In the C.I.P.W. classification the position of the rock is, therefore:—
II., 5, 4, 4-5.

The magmatic name is *Hessose.*

The high felspar content is indicated by the high percentages of lime and alumina giving over 50% of anorthite in the norm. Actually a good deal of this lime and alumina must enter into the modal hornblende. Apart from these points the analysis seems quite normal for a rock of this type, and supports the idea gained from the mineral content that it must be classified in the basic division of the calc-alkali series.

Another specimen from the same locality differs from the rock analysed mainly in containing a smaller amount of felspar. This mineral, which has the composition of a medium labradorite, again shows twinning on the albite, pericline and Carlsbad laws, and contains the numerous inclusions mentioned in the description of the former rock. These phenocrysts, in some cases, consist of a number of individual crystals which have grown together. The felspars again have suffered an alteration round the edges to scapolite and epidote, but not to the extent noted in the rock analysed. The amphibole, also, is somewhat paler.

II. The occurrence of the Mount Barker Springs rock is described by Howchin. He writes that: "A basic dyke, 28 yards wide, occurs about two miles to the north-west of Mount Barker Hill, with a strike directed towards the mount, and can be traced for nearly a mile; its age is undetermined."[5] In a more recent paper[6] the same writer indicates that the intruded rocks are most probably Adelaide Series sediments.

In the hand specimen colourless porphyritic felspars, many measuring up to 5 mm. in length, are embedded in a dark, somewhat greenish groundmass.

Microscopic Features.—The porphyritic texture is again well displayed by the presence of large plagioclase crystals in a groundmass consisting mainly of hornblende and plagioclase.

The felspar is a medium *labradorite* in which albite, pericline and Carlsbad twinning is well developed. Inclusions in the felspar phenocrysts are less numerous, but of the same nature as those in the Woodside rocks.

The *hornblende* also is similar to that in the more felspathic rock at Woodside.

Granules of *scapolite* are associated with some of the felspar phenocrysts.

Both *zoisite* and green *epidote* are frequently surrounded by fine sericitic material, these aggregates constituting alteration products of the felspar.

Small granules of *ilmenite,* changing to leucoxene are plentiful. A small quantity of *sphene* is also present.

Chemical Analysis.

	Percentage.		Percentage.
Silica (SiO_2)	49·29	Carbon dioxide (CO_2)	Nil
Alumina (Al_2O_3)	18·41	Titanium dioxide (TiO_2)	1·01
Ferric oxide (Fe_2O_3)	1·00	Phosphorus pentoxide (P_2O_5)	0·21
Ferrous oxide (FeO)	5·87	Sulphur (S)	0·05
Magnesia (MgO)	8·68	Chromic oxide (Cr_2O_3)	Nil
Lime (CaO)	13·03	Manganous oxide (MnO)	0·15
Soda (Na_2O)	1·18	Barium oxide (BaO)	Nil
Potash (K_2O)	0·28		
Water (combined) (H_2O+)	0·67	Total	99·87
Water (hygroscopic) (H_2O-)	0·04		

The specific gravity is 3·00.

[5] "Geology of South Australia" (sec. ed.), 1929, p. 62.

[6] Trans. Roy. Soc. S. Aust., vol. liii., 1929, pp. 27-32.

The Norm.

	Percentage.			
Quartz	1·20	Q = 1·20		Salic Group = 56·75%
Orthoclase	1·67	}	F = 55·55	
Albite	9·96			
Anorthite	43·92			
Diopside	16·09	}	P = 38·63	
Hypersthene	22·54			
Ilmenite	1·98	}	M = 3·37	Femic Group = 42·34%
Magnetite	1·39			
Apatite	0·34	A = 0·34		
Water	0·71			

In the C.I.P.W. classification the position of the rock is, therefore:—

III., 5, 5, 4-5.

approaching: III., 5, 4, 4-5.

The magmatic name is *Auvergnose-Kedabekase.*

The analysis shows lower alumina, lime and soda than the Woodside rock. This is reflected in the smaller amount of normative felspar. The ferromagnesian content is correspondingly higher. In these points the norms indicate the actual mineralogical differences between the two rocks. It is probable that the less felspathic type from Woodside would be extremely similar, chemically, to that occurring at Mount Barker Springs.

III. As mentioned by Howchin,[7] the basic dyke at Mount Barker Junction is not seen in outcrop, its presence being indicated by loose stones on the surface of cultivated land. In the hand specimen this rock bears an extremely close resemblance to that from Mount Barker Springs.

Microscopic Features.—Porphyritic felspars occur in a groundmass of hornblende and felspar, this structure being similar to that of the rocks described above. The *plagioclase* phenocrysts again contain numerous inclusions which are mostly chlorite. Extinction angles indicate that the felspar is a medium labradorite. This felspar, although it is corroded, differs from that of the other rocks in that no scapolite has been formed, although both *zoisite* and green *epidote* are present in small amount. The twinning of the plagioclase is confined to the albite and Carlsbad types, no pericline twins being seen.

The *hornblende* is similar to that of the other rocks and is somewhat chloritized.

Sphene is a notable constituent, but iron ores are practically negligible.

Chemical Analysis.

	Percentage.		Percentage.
Silica (SiO_2)	49·09	Water (combined) (H_2O+)	0·89
Alumina (Al_2O_3)	18·03	Water (hygroscopic) (H_2O-)	0·05
Ferric oxide (Fe_2O_3)	3·35	Carbon dioxide (CO_2)	Nil
Ferrous oxide (FeO)	4·56	Titanium dioxide (TiO_2)	1·38
Magnesia (MgO)	7·48	Phosphorus pentoxide (P_2O_5)	0·21
Lime (CaO)	12·97	Manganous oxide (MnO)	0·18
Soda (Na_2O)	1·71		
Potash (K_2O)	0·42	Total	100·32

The specific gravity is 3·01.

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(7) *Loc. cit.*, p. 31.

The Norm.

	Percentage.			
Quartz	2·58		Q = 2·58	
Orthoclase	2·22	}		Salic Group = 59·26%
Albite	14·15	}	F = 56·68	
Anorthite	40·31	}		
Diopside	18·71	}	P = 32·12	
Hypersthene	13·41	}		
Magnetite	4·87	}	M = 7·61	Femic Group = 40·07%
Ilmenite	2·74	}		
Apatite	0·34		A = 0·34	
Water	0·94			

In the C.I.P.W. classification the position of the rock is, therefore:—

III., 5, 4, 4-5.

The magmatic name is *Auvergnose.*

The analysis shows the extreme chemical similarity between this and the Mount Barker Springs rock. There are, however, minor variations in the alkalies and the relative amounts of iron and magnesia.

Conclusion.

The mode of occurrence, mineralogical nature, and chemical composition of these three rock types suggest that they are closely related, and that they should be included in that class of rock to which the misleading name *epidiorite* has been given.

The writer would suggest, however, that the compound name *dolerite-amphibolite* could be applied advantageously to types such as have been described in this paper.

ABSTRACT OF THE PROCEEDINGS OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA

FROM THE YEAR NOVEMBER 1, 1930, TO OCTOBER 31, 1931

Summary

A GENERAL DISCUSSION on "Laterite and Lateritic Soils" was introduced by Professor J. A. Prescott, who said that "laterite was originally defined in 1807 from certain soil formations and geological structures in Southern India by Buchanan. Laterites occur throughout a considerable area of Australia, and were first recognised as such in Western Australia by Simpson and by W. G. Woolnough. The essential feature of the laterite consists of a capping or conglomerate of massive or pisolitic iron hydroxide with certain examples of aluminium hydroxide or bauxite. Soil workers have assumed that the process of laterization was a distinct weathering process confined to the tropics, but further investigation has revealed no evidence in support of this, such tropical weathering processes being entirely similar to those occurring in temperate zones. It is suggested, therefore, that laterite, as defined by geologists, is essentially a relic of former soil-forming processes." Professor Prescott then read a letter dealing with the subject by Dr. L. Keith Ward. Mr. R. J. Best then dealt with the chemical aspect, and illustrated his remarks with diagrams.

ABSTRACT OF THE PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA (Incorporated).

FOR THE YEAR NOVEMBER 1, 1930, TO OCTOBER 31, 1931.

ORDINARY MEETING, NOVEMBER 13, 1930.

THE PRESIDENT (Dr. Chas. Fenner) in the chair and 28 members were present.

Minutes of the Annual Meeting, held October 9, 1930, were read and confirmed.

ELECTION OF FELLOW.—John Irvine Miller, C.E., Crystal Brook. A ballot was taken and Mr. Miller was declared elected.

CORRESPONDENCE.—A letter received from Dr. A. B. Walkom, Secretary of the Linnean Society of New South Wales, was read, relating to the publication of reproductions on coloured plates of some of the Australian native flora.

A GENERAL DISCUSSION on "Laterite and Lateritic Soils" was introduced by Professor J. A. PRESCOTT, who said that "laterite was originally defined in 1807 from certain soil formations and geological structures in Southern India by Buchanan. Laterites occur throughout a considerable area of Australia, and were first recognised as such in Western Australia by Simpson and by W. G. Woolnough. The essential feature of the laterite consists of a capping or conglomerate of massive or pisolitic iron hydroxide with certain examples of aluminium hydroxide or bauxite. Soil workers have assumed that the process of laterization was a distinct weathering process confined to the tropics, but further investigation has revealed no evidence in support of this, such tropical weathering processes being entirely similar to those occurring in temperate zones. It is suggested, therefore, that laterite, as defined by geologists, is essentially a relic of former soil-forming processes." Professor Prescott then read a letter dealing with the subject by Dr. L. Keith Ward. Mr. R. J. BEST then dealt with the chemical aspect, and illustrated his remarks with diagrams. Mr. J. G. WOOD described the ecology of the vegetation on tropical and Australian laterite soils. In Burma *indaing* forest, *Diptirocarpus tuberculatus*, with associated stunted shrubs was confined to the laterite. The vegetation of the sand plains under about 20-in. rainfall was dealt with, and it was shown that it was not a variant of mallee, as Diels suggested. In South Australia there are three large laterite areas—at Mount Compass, southern Fleurieu Peninsula, and central Kangaroo Island. Stunted stringybark *Eucalyptus Baxteri* is the dominant shrub in soils containing laterite gravel, and the shrub-gum *Eucalyptus cosmophylla*, with *Casuarina striata* is dominant where the ironstone crusts are exposed. Mr. Wood discussed the relation of these shrubs to the climax stringybark community which represented the highest developmental phase of the vegetation in the climate under consideration. The scrub on laterite was an edaptic sub-climax of the stringy-bark

forest, prevented from normal development to high forests by soil conditions. He considered that the vegetation on laterite soils was not in equilibrium with its present environment. Mr. C. T. Madigan said that "laterite was a product of rock in arid regions, not, perhaps, necessarily tropical. Laterite was found overlying granites and gneisses and old igneous rocks generally, and is best known over this class of rock. It was a residual soil, and never transplanted. Consists of hydrated iron oxides, hydrated alumina (bauxite), clay, quartz grains, etc. Varies from pure limonite (hydrated iron oxide) to pure bauxite (hydrated alumina). The sand grains and clay are variable. There are large deposits in the Darling Range, near Perth (W.A.), which give about 35% soluble alumina, and 30% iron oxide. Some has as much as 50-60% of soluble alumina, which is a good aluminium ore." Mr. Madigan then discussed the conditions which determine whether rock silicates shall decay to clay (hydrated silicate of alumina) or to bauxite (hydrated alumina with free silica causing silicification, so common in Central Australia). Specimens were exhibited of Kangaroo Island laterite, identical in appearance to some from the Irwin River in Western Australia; amphibolite changing to laterite, from Magna, Western Australia; slate from Armadale undergoing a similar change, and typical laterites from Canegrass, Western Australia. Dr. R. Lockhart Jack said that "the great development of laterite in Western Australia is undoubtedly a product of past activity, and similar old lateritic bodies occur in South Australia to the west and north-west of Tarcoola and south of the Musgrave Ranges, as well as in the south. Topography, the nature of the underlying rocks, climate, and the position of the ground-water table must have affected its formation. The comparison with the Desert Sandstone is difficult, as the laterite is characteristic of the older rock formations such as granite, gneisses, and schists, while the silicification which constitutes the Desert Sandstone is confined to the Jurassic and younger series. The silicification is most complete at the surface, and with increasing depth gradually merges into weathered material. It has affected the Eyrian beds, the Cretaceous and the Jurassic and the physical state of the bed that has been silicified is shown in the product, which ranges from fine-textured shale, completely silicified, to quartzitic conglomerate. Some of the original beds are ferruginous, and the Desert Sandstone over them may be limonite cemented. From topographic considerations there is no doubt but that this great silicification occurred over a widespread, ill-drained peneplain, and under somewhat wetter conditions than are known at present. Like travertine, it was formed by the capillary rise of mineralized water. With dissection and the development of drainage the process ceased save at favoured localities, such as in the vicinity of lakes where the water-table is within reach of the surface. At Lake Bring (gneiss-bottomed) and Lake Woorong (Jurassic sands and grits) there are obviously later crusts, probably Recent in age. At Lake Bring both iron and silica cement a fine sand-grain aggregate, while at Lake Woorong the cement is siliceous with a similar aggregate, which is dissimilar in grain to the subjacent Jurassic grits, but may have been derived from them by subsequent redistribution. The Woorong crust, exposed over many acres, is about two feet thick. Originally flat, it has been broken and tilted in all directions by the rise of gypseous solutions from the saline ground-water and the deposition of microcrystalline gypsum beneath the crust. The formation of this gypsum argues a change of conditions in the climate resulting in increased salinity. There seems to be no doubt but that silicification, though no longer taking place on a large scale, has persisted till very recently, and that with the most recent silicification there has occurred, where supplies of iron are available, recent limonitic cements."

The Chairman thanked the members who had dealt with the various aspects of the subject.

Ordinary Meeting, April 9, 1931.

The President (Dr. Charles Fenner) occupied the chair and 30 members were present.

Minutes of the Ordinary Meeting, held on November 13, 1930, were read and confirmed.

The President extended a welcome to Mr. J. M. Black on his return from abroad, and then formally handed to him the Sir Joseph Verco Medal, which had been awarded by the Society to Mr. Black during his absence.

Mr. Black "thanked the President and Fellows for the great honour which the Society had seen fit to confer on him. He also wished to express his gratitude to Dr. L. Keith Ward, Mr. J. F. Bailey, and Dr. R. S. Rogers for their kindly, and too flattering, references to his work at the meeting of July 10 last, when it was decided to confer the medal upon him. The name associated with the medal must always awake pleasant recollections in the minds of those Fellows who, in past years, sat under the genial presidency of Sir Joseph Verco. That presidency endured for no less than 18 consecutive years from 1903 to 1921—a record perhaps only exceeded by that of Sir Joseph Banks, who for 25 years occupied the position of President of the Royal Society of London." Mr. Black, who represented the Royal Society, as well as several other Australian institutions, at the International Botanical Congress held at Cambridge in August, 1930, said "he hoped it would not be out of place if he gave a short account of the work accomplished in the Section of Taxonomy and Nomenclature, to which he was attached. It was at first feared that an agreement might not be reached between a large section of the Botanists of the United States of America and the rest of the world on the vexed question of *nomina generica conservanda,* but such a spirit of friendliness and compromise was apparent from the very beginning of the proceedings that there is no doubt that uniformity of nomenclature will be attained in the future. Indeed, a considerable list of additional and well-known generic names was proposed for conservation, but as it was impossible for a large assembly in one week to deal with such a complicated subject, its consideration was relegated to a small committee comprising some of the ablest and most experienced authorities on nomenclature. It was remarkable that three of the four members of the committee which drew up the International rules of the Vienna Congress in 1905 (Dr. J. Briquet, of Geneva; Dr. H. Harms, of Berlin; and Dr. A. B. Rendle, of London) are taking an active part in the same work today as an aftermath of the Cambridge Congress. The Congress was composed of over 1,000 members and represented almost every nation, including Japanese, Chinese, and Indian botanists. The only notable absentees were the Russians. Several Professors from Moscow, Leningrad, and Kiev were inscribed on the official programme to read papers on various subjects, but as none of them appeared, and no explanation was received, the cause of their non-attendance could only be surmised. From the social and scientific points of view, the gathering was a great success. There was a reception by the British Government at the Imperial Institute in London, and at Cambridge there were hospitable receptions by the Masters of St. John's College and of Downing College. At the Royal Botanic Gardens of Kew, the cosmopolitan guests were entertained by the popular Curator, Dr. A. W. Hill."

Election of Fellow.—Charles Ernest Cameron Wilson, M.B., B.S. A ballot was taken and Dr. Wilson declared elected.

Nomination as Fellows.—Hugh McIntyre Birch, M.R.C.S., M.R.C.P., medical practitioner, Mental Hospital, Parkside; Joseph Ronald Andrew, minister of religion, Woodside; Eric Aroha Rudd, student, 10 Church Street, Highgate.

The President drew the attention of members to invitations received to appoint Delegates to attend the Faraday and the Clerk Maxwell Celebrations at

the University of Cambridge, the Centenary Meeting of the British Association for the Advancement of Science, and the Centenary of the College of France, which will take place during 1931.

The President then requested all members who were preparing papers for presentation during the year, to advise the Secretary, so that a probable cost of publication can be obtained for the guidance of the Council.

The President expressed the sincere regret of the Society in the loss sustained by the departure from this State of Dr. R. Lockhart Jack, and on behalf of the Council and members requested the Secretary to convey to Dr. Jack the very best wishes and success in his new field of labour.

Papers—

"A Delineation of the Pre-Cambrian Plateau in Central and North Australia, with Notes of the Impingent Sedimentary Formations," by Chas. Chewings, Ph.D., F.G.S., was formally communicated by Mr. W. W. Weidenbach, A.S.A.S.M. Dr. Chewings, who was present, was then invited by the President to give a resumé of the work covered by his paper.

Mr. Madigan, Prof. Howchin, and Dr. L. Keith Ward took part in the discussion which followed. Dr. Ward drew special attention to the age of the sediments forming Ayers' Rock, as suggested by Dr. Chewings, and said that he doubted, on lithological grounds, if they were younger than Cambrian age.

The President expressed the appreciation of the Fellows to Dr. Chewings for his valuable contribution to the Geology of Central Australia.

Exhibits.—Mr. N. B. Tindale exhibited some fossils from Mount Ultim, and from Undala, Central Australia; they were found in horizontally bedded littoral marine sandstones, and although not yet critically determined appear to have a facies characteristic of the Ordovician. Professor Howchin exhibited photographs of Cryptozoön from the type district at Saratoga Springs, New York State, taken by Mr. A. R. Riddle (formerly of Adelaide, now of New York.) The fossils are photographed *in situ*, exposed on a glaciated pavement. They also include a photograph of a metal tablet placed on the ground, containing the following inscription in relief:—"Cryptozoön Ledge. The fossils on the surface of the rock are remains of marine plants or algae which grew over the bottom of the ancient Cambrian sea. They are among the oldest plants of the earth. They grew in cabbage-shaped heads, and deposited lime in their tissues. The ledge has been planed down by the action of the great glacier which cut the plants across, showing their concentric interior structure. The scientific name of these plants is Cryptozoön proliferum Hall." Mr. A. M. Lea exhibited some stag-beetles *(Lucanidae)* from New Guinea, showing an extraordinary range of variation in the males, and for comparison the common stag-beetle of Europe *(Lucanus cervus)* and many Australian species. Also a Katipo, the dangerous red-backed spider *(Lactrodectus hasselltii)* and some new hatched ones. Another Katipo laid some eggs in captivity on January 14; still held captivity and without any possible connections with a male, a second lot of eggs was laid on February 18; these duly hatched. On March 26 a third lot was laid which were now coming out. Mr. Madigan exhibited a map he had compiled of the region in the vicinity of the MacDonnell Ranges from observations made during his recent aerial reconnaissance, and a subsequent visit to the locality; together with information obtained from other observers. The President (Dr. Chas. Fenner) exhibited specimens and casts of leaves of *Magnolia Browni*, from Baker's gully, near Clarendon. These are found in extensive deposits of ferruginous sands and grits, preserved in part on the old eastward tilted peneplain surface. This fossil was formerly regarded as Cretaceous, but is now known to be Miocene. The matter has a definite bearing on the physiographic history of the Mount Lofty Ranges, as well as on the interesting question of the origin of our lateritic soils. Mr. J. M.

Black showed dried specimens of *Alhagi camelorum* or "Camel Thorn," which has appeared in cultivated ground near Jamestown. It is a spiny shrub inhabiting desert country between Nubia and North-western India, and might become a pest here.

Ordinary Meeting, May 14, 1931.

The President (Dr. Charles Fenner) occupied the chair and 20 members were present.

Minutes of the Ordinary Meeting, held April 9, 1931, were read and confirmed.

Apologies were received from Dr. L. Keith Ward, Mr. B. S. Roach, and Mr. F. C. Martin.

The President referred to the publication of Part III., "The Building of Australia, and the Succession of Life," by Professor Walter Howchin. It was agreed that a letter expressing the congratulations of the Society be sent to Professor Howchin.

The President announced that an invitation had been received to send a Delegate to the Centenary Meeting of the Royal Society, Dublin, which will be celebrated in June of this year.

Election of Fellows.—Hugh McIntyre Birch, M.R.C.S., M.R.C.P., medical practitioner, Parkside; Joseph Ronald Andrew, Woodside; and Eric Aroha Rudd, Highgate, were balloted for and declared elected.

Nominations as Fellows.—Nelly Hooper Woods, M.A., school teacher, Mount Torrens; Charles Chewings, Ph. D., F.G.S., "Alverstoke," Glen Osmond, were read.

Papers—

"A Table Showing the Class Relations of the Aranda," by H. K. Fry, M.B., B.S., B.Sc., who exhibited diagrams showing the family relationships of these natives. Mr. N. B. Tindale exhibited a diagram mounted on a cylinder, to illustrate the four class-marriage classifications of the Iliaura tribe, MacDonnell Ranges, Central Australia. This diagram was based on the one devised for the Aranda tribe by Dr. H. K. Fry. The President, the Rev. J. C. Jennison, and Dr. T. D. Campbell took part in the discussion.

"The Anatomy of an Australian Leech, *Helobdella bancrofti*," by Mrs. Effie W. Best, M.Sc.

Exhibits.—Mr. A. M. Lea exhibited a drawer of Cuckoo-wasps. These remarkable insects are parasitic in the nests of mud-wasps, in which they live like cuckoos in the nests of other birds, and similarly destroy the young of the rightful inhabitants. Also a drawer of dung beetles, of which three species of *Pedaria* act as cuckoos, of the genus *Onthophagus*. Mr. H. H. Finlayson exhibited a photograph of the maxilla of *Neobalaena marginata*, with baleen *in situ*, and a baleen plate, collected by him on the West Sister Island, Bass Strait; which is now deposited in the South Australian Museum. He stated that although there were records of three strandings of this species in South Australian waters, which led to the acquiring of osteological material, the baleen of the adult was previously not represented in the Museum collections.

Ordinary Meeting, June 11, 1931.

The President (Dr. Chas. Fenner) occupied the chair and 44 members were present.

Minutes of the Ordinary Meeting, held May 14, 1931, were read and confirmed.

Election of Fellows.—Miss Nelly Hooper Woods, M.A., and Charles Chewings, Ph.D., F.G.S., were balloted for and declared elected.

Nomination as Fellow was received from Professor Sir Charles James Martin, Kt., C.M.G., D.Sc., University of Adelaide.

Papers—

"Geological Notes of the Iliaura Country, North-east of the MacDonnell Ranges, Central Australia," by N. B. Tindale, was taken as read.

A number of popular lectures on "The Status of the Native Flora of South Australia," introduced by Mr. J. M. Black, were then delivered. Those contributing being Dr. R. S. Rogers, Mr. J. F. Bailey, Mr. J. G. Wood, Dr. R. Pulleine, and Professor J. B. Cleland.

Mr. J. M. Black introduced the subject and spoke on "The Great Changes taking place in our Native Flora by Introduced Plants."

Dr. R. S. Rogers described "The Orchids of this State."

Mr. J. F. Bailey, "Cultivated Plants."

Mr. J. G. Wood outlined the work done at Coonamore.

Dr. R. Pulleine, "Some Flora of the Gawler Ranges."

Professor J. B. Cleland, "Notes on Collecting."

Mr. J. M. Black said "our Native Flora was being replaced to a very serious extent by alien introductions, of which many were weeds, although some, such as the clovers and some foreign grasses provided useful fodder. Near towns, and especially on the parklands of Adelaide, native plants had almost disappeared, and some of those which had taken their place, such as the Onion Grass *(Romulea rosea)*, the Nut Grass *(Cyperus rotundus)*, and the Two-leaved Cape Tulip *(Homeria miniata)* were pests for which nothing good could be said. On the north parklands almost the only Australian survivals were the graceful Spear Grass *(Stipa variabilis)* and the yellow-flowered liliaceous plant, *Bulbine bulbosa*, and their extent was now closely restricted. Isolation, which had lasted for tens of thousands of years, and the absence of all large grazing animals and of rabbits, had rendered the Australian flora incapable of contending with the hardier plants of other continents, and especially with those coming from countries whose climate resembled our own. The number of alien species now growing spontaneously in South Australia (including several garden escapes not yet thoroughly established) was about 450, while the native species, now almost confined to hilly and rocky country and the dry north, numbered over 2,000, but it must be remembered that the number of individual plants in foreign species was, usually, much greater than in those which are indigenous."

Dr. R. S. Rogers said that "the Orchids in the State are represented by terrestrial forms only, the dry climate, the absence of high mountains and deep valleys being unfavourable to the growth of epiphytes. A transitional, *Dipodium punctatum*, which still has its epiphytic representatives in India and the Malayan Archipelago, occurs in the Mount Lofty Ranges. This is a leafless species, deficient or destitute of chlorophyll, and in its early stages dependent, to some extent, for its nutrition upon the roots of other plants *(e.g., Candollea)*.

"The distribution of the family is probably determined by an average annual rainfall of 10 inches, roughly represented in this State by Goyder's Line. Beyond this line no orchids have been recorded. It will thus be seen that their distribution occupies a comparatively small portion of this large State and is chiefly coastal in character. As a matter of fact, of the 106 species on our census, very few are to be found more than 100 miles north of Adelaide.

"Those which penetrate furthest into the interior belong to the genera *Pterostylis*, *Caladenia*, and *Thelymitra*.

"It seems remarkable that any representative of the former genera, the species of which are so specially adapted for shade and moisture, should ever acquire the physical characters necessary for existence in these comparatively arid regions.

They meet their xerophytic conditions by enlargement of their root-system thickening of their stems, withering of their leaves before flowering, and the development of rufous tints in otherwise green flowers. Hairs are not produced on the vegetative parts of the plant, and only very sparsely on the flowers themselves. The Caladenias, with their somewhat woody stems and very hairy habit, are better equipped for the rigid conditions under which they have to live, and except that they are stunted in growth maintain a hardy existence in the far north with few modifications.

"The few Thelymitras that occur in these districts increase their root-system and reduce their foliage as in the case of *Pterostylis.* In no case do they develop hairs.

"There is no doubt that the tubers of some of these plants do not vegetate annually, but remain dormant for lengthy periods during unusually dry seasons.

"Owing to the geographical position of South Australia as the Central State, it is hardly to be expected that any of its genera should be endemic. As a matter of fact, out of 20 indigenous genera, no less than 16 are shared in common with all the other States; *Dipodium, Orthoceras,* and *Spiranthes* do not extend into Western Australia, but are distributed over other parts of the continent, and the remaining one, *Leptoceras,* extends from the Swan River along the southern coast to Port Phillip, but is not recorded from Tasmania.

"In this enumeration the Northern Territory has not been included, owing to the scantiness of our knowledge of the orchidaceous flora of that region. There is, therefore, no genus which can be said to be the exclusive property of South Australia.

"Some of our genera have a wide climatic range and extend well into the Australian tropics; rather more than half of them are represented in New Zealand; about a third have been reported from the Pacific and such distant stations as the Malayan Archipelago and New Guinea; one *(Microtis)* occurs in China, and another *(Spiranthes)* which is almost cosmopolitan in many temperate and tropical regions of the globe.

"Although nearly all our genera are essentially Australian types, only three *(Glossodia, Eriochilus,* and *Leptoceras)* are peculiar to Australia. Others, such as *Pterostylis, Caladenia, Thelymitra, Prasophyllum, Diuris,* etc., with our continent as a centre of dispersion, have outlying representatives in neighbouring countries and islands; whereas a few, including *Corysanthes, Cryptostylis, Dipodium,* and possibly *Microtis,* may be regarded as Asiatic in their origin.

"*Spiranthes,* to which I have already referred, has probably reached us from the New World, where it is particularly rich in species in Central and South America.

"With the exception of *Dipodium,* which is the sole representative of the tribe Vandeae, all South Australian orchids belong to the Neottieae.

"By far the best developed genera are:—*Pterostylis,* with 21 species; *Caladenia,* with 20 species; *Thelymitra,* 17; *Prasophyllum,* 14; and *Diuris,* 8.

"*Pterostylis,* known by the vernacular name of "Greenhoods," is of special interest on account of its irritable labellum and intricate mechanism for fertilization by insects. One of its species has reached New Guinea, and others are recorded from New Caledonia and New Zealand. The *Caladenias,* popularly called "Spiders," are probably the most showy of our orchids and attract much attention, not only on account of their beauty, but also on account of their profusion. They have no very definite odour but are all cross-pollinated by insects. A small member of the genus has penetrated as far north as Java, and others are represented in New Zealand and New Caledonia.

"*Thelymitra* contains several very showy species, some of which are delightfully fragrant. About half of the species are entirely dependent upon insects for

their fertilization, the flowers of the others only expand on hot sunny days and are self-fertilized.

"It is well represented in New Zealand, has been recorded from the Pacific Islands, and has pushed as far north as the Philippines. *Prasophyllum*, which is usually fertilized by insects but sometimes self-pollinated, is probably the least conspicuous of our genera. Some members of the genera are exceptionally small with very minute flowers, but in Western Australia I have seen others nearly six feet high, which constitute a conspicuous feature of the landscape. In this State the latter species not infrequently attains a height of 4 feet 6 inches. As in the case of *Thelymitra*, some species are delightfully fragrant.

"*Diuris* is popularly known as 'Two-tails.' The species are all dainty and attractive and are collected in great numbers by 'flower-gatherers.' Fortunately, like the Caladenias, they are very abundant, otherwise they would soon be exterminated.

"They are entirely dependent on cross-fertilization. Some are pleasantly perfumed but the majority are without scent. It is at first rather difficult to understand that a genus so admirably adapted for dispersion, should be out-rivalled in distribution by *Thelymitra*. The reason possibly is, that the latter is more capable of adapting itself to its environment by abandoning the habit of cross-pollination and in rapidly acquiring that of self-pollination which makes it independent of any particular insect agent. A single species of *Diuris* has been recorded from Timor; otherwise the genus would appear to be restricted to Australia.

"The endemic species in this State appear to be limited to about a dozen. Their number may be still less as our knowledge increases. Species regarded as endemic a few years ago have since been discovered in other States."

Mr. J. F. Bailey said that "South Australia is not so well off in decorative species of plants as are some of the other States, those to the East embracing in their floras such ornate subjects as the Waratahs, Christmas Bells *(Blandfordia)*, Wheel of Fire *(Stenocarpus)*, Flame Trees *(Brachychiton)*, and the large-flowering terrestrial Orchids—*Phaius* and *Calanthe;* and Western Australia the Christmas Tree *(Nuytsia)*, Verticordias, Hoveas, Red and Pink Flowering Gums, Kangaroo Paws, and Leschenaultias. Our flora is also short of Tree Fern and Palms, which are sought after by horticulturists for providing landscape effects. The only representatives being *Todea barbara* among the former and *Livistona Mariae* among the latter.

"Nevertheless, we have a number that could be used in the garden, where they would hold their own with many of the imported plants, and the following have been noticed in gardens in and about Adelaide.

Iridaceae—*Orthrosanthus multiflorus* and *Patersonia glauca*.

Amaryllidaceae—*Crinum pedunculatum*, the Murray Lily, and *Calostemma purpureum*.

Proteaceae—*Hakea multilineata, Banksia ornata, Grevillea lavandulacea*, and *G. ilicifolia*.

Chenopodiaceae—*Atriplex nummularia*, the Old Man Saltbush for hedges.

Capparidaceae—*Capparis Mitchellii*, Native Orange, and *C. spinosa*, the Caper-bush.

Pittosporaceae—*Pittosporum phillyreoides*, the Native Willow, and *Bursaria spinosa*, the Native Box.

Leguminoseae—*Acacia pycnantha*, the Golden Wattle; *A. dodonaeifolia*, the Port Lincoln Wattle (used for hedges); *A. decurrens*, the Black Wattle; *A. longifolia*, and *A. furnesiana*. *Cassia Sturtii, C. eremophila*, and *C. artemesioides*. *Templetonia retusa, Goodia lotifolia, Crotalaria Cunninghamii*, the Bird Flower; *Clianthus speciosus*, the Sturt Pea; and *Swainsona* of several species.

RUTACEAE—*Boronia Edwardsii, B. pilosa, Correa rubra,* and *C. alba.*
TREMANDRACEAE—*Tetratheca pilosa.*
MALVACEAE—*Hibiscus Huegelii, Cienfuegosia hakeifolia,* and *Gossypium Sturtii,* Sturt's Rose.
VIOLACEAE—*Viola hederaceae,* the Native Violet.
MYRTACEAE—*Leptospernum,* of several species; *Callistemon regulosus,* the Scarlet Bottle-brush; *Melaleuca squamea, M. gibbosa,* and *M. acuminata, Eucalyptus cladocalyx,* and *E. leucoxylon,* with rose-coloured flowers.
LABIATAE—*Prostanthera lasianthos* the Mintbush.
SCROPHULARIACEAE—*Veronica Derwentia,* with blue and also white blooms.
MYOPORACEAE—*Myoporum insulare,* Native Juniper or Boobialla, used for hedges; and *Eremophila alternifolia.*
GOODENIACEAE—*Scaevola aemula.*
COMPOSITAE—*Olearia grandiflora, O. pannosa,* and *O. teretifolia, Helichrysum bracteatum,* one of the "Everlastings," and *Calocephalus Brownii,* used for edging."

Professor CLELAND, referring to Mr. Black and the "Handbook of Flora of S.A.," said, "The preparation of this Handbook has clarified the position and put into the hand of all a ready means of ascertaining what species have been recorded in this State and the distribution of each. How important exact identification may be is well illustrated in the recognition, for instance, of weeds, some of which may be pests and other familiar ones innocuous. One saltbush may be good fodder and another such as *Atriplex Muelleri,* common as a garden weed in Adelaide suburbs and even growing in the University grounds, quite useless. One species may yield an economic product, as for instance *Nicotiana excelsior,* a large-leafed tobacco chewed by the natives in Central Australia, and another very like it, in this case *Nicotiana suaveolens,* be without narcotic effect. I consider Mr. Black's 'Flora of South Australia' the greatest Australian botanical work for more than fifty years. To be a systematist requires not only basal knowledge but an enormous range of practical experience and countless hours of toil. No branch of science is harder, and in these days, I am afraid, the systematic botanist is often not given his place at the top of the botanical tree—so to speak, its most precious and toothsome fruit—but is apt to be displaced by other aspects requiring a less-long apprenticeship.

"As a result of the publication of Mr. Black's Handbook a great impetus was given to collecting, as the large Appendix to the work shows the extent of the additions. As one who is a collector and has had the privilege of helping Mr. Black, I would like to say a few words on the subject of collecting. Though we are continually thinking that finality has been reached and that all species for a district have been discovered, additions even of new species continue to be made. During the period of the publishing of Black's Flora, Morialta yielded a new species of spear-grass and a new State record in *Lomandra caespitosa.*

"Some species escape observation on account of their flowering at an unusual period of the year. About 16 years or so ago, in journeying between Sydney and Adelaide, I dropped off the Melbourne Express at Coonalpyn in the early hours of the morning and had a look round. The stay was well worth while, as it yielded at least one new species, a heath *Leucopogon Clelandii,* as named by Mr. Cheel of the Botanic Gardens in Sydney. For long this remained the only record. A specimen not in flower but presumably this was recorded for Kangaroo Island, now I find it quite a widely distributed species growing in damp sandy loam with a clay bottom. It occurs near Encounter Bay, and I have just collected it in a heath near Mount Burr, and also near Bangham in the South-East. It is a May-flowering species, it being small is likely to be missed during the rest of the year. One does not look in the late Autumn as a time for flowering but several of our

Epacrids bloom in May. *Epacris impressa* is a great sight. *Styphelia exarrhena* with rather prickly leaves and white flowers is very pretty. The flowering time of a plant is often a very definite and limited period and in many cases occurs at the same time each year. This is very important as a separation by even only a few days will prevent the chance of cross-fertilization. Thus a slight mutation, causing a group of seedlings to flower a few days earlier or a few days later than the rest of the species, secures in some cases as complete isolation as separation by oceans. The new race must breed within itself, and gradually, minor variations build up what is a new species. We have had plants, isolated on islands, tend in the long run to become specifically distinct from those on the mainland. The same result may follow mutational departure from the normal flowering time. The two little grasses, *Aira caryphythus* and *A. ininata,* seem to flower at different times.

"*Eucalyptus*, as far as I can see, flowers at irregular times in many cases. An accurate record of flowering periods would be of considerable interest. What seems to me very extraordinary is that all the plants of a particular species that is in flower will be in flower together over a very wide expanse of country and in localities differing in surroundings and altitude. If *E. rostrata* (a rather shy flowerer) is in bloom, every red gum tree practically that one meets with over a very wide range will be in flower. This may even be a guide as to the identification of the species at a distance. If it is in flower it must almost certainly be such-and-such which is in bloom. As the Eucalypts flower at irregular periods, from time to time flowering periods of two species will overlap and this gives a chance for cross-fertilization. It has recently been suggested that most, if not all, of our Eucalypts and Proteaceae are really hybrids, because so many pollen grains are abortive and so much seed is sterile. I must say that I cannot follow the late Professor Lawson to the extent he implies, but true crosses do unquestionably occur, and we recently had an example, found by Mr. Julius and Mr. Pinches, of the Forestry Department, at Mount Burr, the tree being an obvious cross between *E. rostrata* and *E. ovata.*"

In the discussion which followed, Professor Richardson endorsed the view expressed by Mr. Black, that the native herbaceous species of Victoria and South Australia were being gradually replaced by alien species. Prior to the settlement of Australia, the edible endemic flora was in equilibrium with a light grazing, nomadic, marsupial population. The advent of the white man with his plough, fire-stick, and his herds of grazing cattle and sheep, and incidentally his droves of rabbits, upset the age-old balance between the endemic flora and native fauna. The floristic balance of vegetation was destroyed, and a new impetus was given to competitive influences.

The domestic animals graze with an intensity far in excess of the native fauna, because the animals are confined in relatively large numbers on specific areas, whereas prior to settlement the nomadic marsupials were free to roam over the entire continent.

The most marked result of the imposition of this intensive biotic factor on native species was to cause the palatable, nutritious grasses, such as the Danthonias, Themelias, and Stipas to be eaten out and replaced by the more aggressive introduced aliens.

In the northern parklands, except on the stony dry hillsides, the native vegetation had been almost entirely replaced by such unpalatable species as *Romulea,* or by plants with a rosette habit of growth, such as *Erodium,* largely as a result of continuous heavy grazing by stock taken on agistment.

Investigations on native pastures at the Waite Institute showed that by the cutting of pasture at fortnightly intervals for two years—thus simulating intensive grazing—the native species were almost entirely replaced by exotic species.

In the arid areas the indigenous perennial species of *Kochia* and *Atriplex* were better able to compete with exotic species, but even at Koonamore, as was shown by Mr. Wood, overgrazing had led to the destruction of edible indigenous species, and the process of regeneration was exceedingly slow.

Thus the introduced species were better able to withstand the effect of the biotic factor than the indigenous species, and it seemed inevitable that in course of time, especially in the settled areas of the State, the exotic species must ultimately replace the native species.

Looking at the matter from the economic point of view, the introduction of exotic species had resulted in a great increase in stock-carrying capacity of pasture lands. In view, however, of the objectionable characteristics of many introduced species, the suggestion of Professor Cleland for some system of controlled immigration of alien species should be supported.

Ordinary Meeting, July 9, 1931.

The President (Dr. Chas. Fenner) occupied the chair and 38 members were present.

Minutes of the meeting held on June 11, 1931, were read and confirmed.

Election of Fellow.—Professor Sir Charles James Martin, Kt., C.M.G., D.Sc. A ballot was taken and Sir Chas. Martin declared elected.

The President acknowledged, with thanks, the kindness of Professor Walter Howchin in presenting to the Society two volumes, comprising 68 papers, which contained researches of the Professor in connection with the Geology of South Australia, and expressed the very deep appreciation of all the members. Sir Douglas Mawson supported the remarks of the President, and expressed his admiration for the manner in which Professor Howchin had carried out, and was still carrying out, his work. Professor Howchin thanked the President, Sir Douglas Mawson, and the Fellows for the expressions of appreciation.

The President extended a welcome to Miss Nelly Woods and Dr. Chas. Chewings as new Fellows.

Papers—

"On the Class System, Kinship, Terminology, and Marriage Regulations of the Australian Native Tribes," by H. K. Fry, B.Sc., M.B., B.S.

"Notes on Some Miscellaneous Coleoptera," by Arthur M. Lea, F.E.S.

Discussion on Mr. N. B. Tindale's paper, "Geological Notes on the Iliaura Country, Central Australia." Mr. Tindale gave a brief geological description of the country embodied in the paper, which was presented at the last Ordinary Meeting of the Society, and taken as read. Professor Howchin drew attention to the fact that the paper proved the existence of Ordovician beds a considerable distance farther north-easterly than previously recorded, namely, to the north and east of the MacDonnell Ranges.

Sir Douglas Mawson and Mr. Madigan also took part in the discussion.

The President then expressed the pleasure of the Fellows at the presence of one of the most distinguished Fellows of the Society, Sir Douglas Mawson, and congratulated him on the success of his two expeditions to the Antarctic. Sir Douglas Mawson thanked the President and Fellows for their expressions of goodwill.

Exhibits.—After reading his paper, Mr. Lea exhibited some buffalo flies from North Australia, where they are seriously troublesome to cattle; also a remarkable fly from Sydney, which is parasitic upon cockchafer beetles; and some stag flies from Papua, with horns on the head of the males like those of stags. Sir Douglas Mawson made a few introductory remarks in connection with the finding of Meteoric Iron in Central Australia, the details of which were then explained

by Mr. A. R. Alderman, who said that the specimens exhibited were some of the 800 odd collected around the twelve or thirteen meteoric craters at Henbury Station, Central Australia. The largest crater is oval in shape and 200 yards long and 50-60 feet deep. This crater is second only in size to the great crater at Canyon Diablo, Arizona. After the discussion which followed, the President formally thanked Mr. Alderman for his exhibit. Mr. H. H. Finlayson exhibited and made some remarks upon parts of a steel trap which had been chewed by a large male Tasmanian Devil, *Sarcophilus harrisi*, which was taken by him in western Tasmania. The skull of the animal was shown, also some of the stomach contents which included part of a ·303 bullet ingested with a wallaby carcase used for bait. Dr. Wm. Christie exhibited some leaves preserved in Bailey's solution (glycerine 1 and water 4), and a series of pictures of plants and flowers drawn by pupils in the State schools who were affected by colour blindness. The President exhibited fossil leaves of *Magnolia* and Laurel obtained from Baker's Gully in the Mount Lofty Ranges. Mr. C. T. Madigan exhibited geological specimens of Archaeocyathinae limestone from the MacDonnell Ranges (River Ross), which was the first discovery of this Cambrian fauna in Central Australia; also some Cryptozoön limestone from Central Australia, and some large crystals of mica, tourmaline, felspar, sargenitic quartz (tourmaline needles in quartz), and garnet from Harts Range, Central Australia.

Professor T. Harvey Johnston then expressed the very best wishes of the Fellows to the President, on a safe, happy, and successful journey to England, where Dr. Fenner would be attending various scientific functions as the representative of this and other societies in Australia. The President thanked the Fellows for the expressions of goodwill and kind remarks.

Ordinary Meeting, August 13, 1931.

The Junior Vice-President (Professor J. A. Prescott) occupied the chair and 29 members and visitors were present.

Minutes of the meeting held on July 9, 1931, were read and confirmed.

The Chairman apologized for the absence of the President (Dr. Chas. Fenner) who was proceeding overseas to attend various scientific celebrations, and the senior Vice-President (Professor T. Harvey Johnston) who was in Central Australia with the Adelaide University Anthropological Expedition.

The Chairman informed the members that he was very pleased to be able to state that the services of Mr. J. F. Bailey would still be retained by this State at the Botanic Gardens, and also as a member of Council of this Society.

Professor Prescott then asked that consideration be given to making an Award of the Sir Joseph Verco Medal for 1931, and submitted the name of Sir Douglas Mawson as the only recommendation from the Council. Professor Prescott gave a brief account of the high qualifications held by Sir Douglas, his contributions to the knowledge of the Geology of this State, and his important exploration work in the Antarctic. Mr. J. M. Black formally moved, and Mr. B. S. Roach seconded, that the recommendation of the Council be confirmed.—Carried.

Nominations as Fellows.—Oscar Westcott Frewin, M.B., B.S., medical practitioner, Hindmarsh, and John Matthew Dwyer, M.B., B.S., medical practitioner, Adelaide Hospital, were read.

Papers—

"A Study of the Vegetation of the Lake Torrens Plateau, South Australia," by (Miss) B. Jean Murray, B.Sc., communicated by J. G. Wood, M.Sc.

Mr. J. M. Black, Mr. C. T. Madigan, Mr. W. Weidenbach, Mr. E. H. Ising, and Professor J. A. Prescott took part in the discussion of the paper.

"Atmospheric Saturation Deficit in Australia," by Professor J. A. Prescott, M.Sc., A.I.C.

Mr. Edwin Ashby and Mr. J. G. Wood took part in the discussion which followed.

Mr. Edwin Ashby then delivered an instructive and interesting lecture on "The Evolution of Chitons," illustrated by drawings and lantern slides. At the conclusion the Chairman expressed the thanks of the members to the lecturer.

Special Meeting, September 10, 1931, at 7.45 p.m.

The Senior Vice-President (Professor T. Harvey Johnston) occupied the chair and 25 members were present.

Consideration was given to the Amended Rules and By-laws of the Society as recommended by the Council, a copy of which had been sent to all members resident in the State.

Further amendments were made to:—

Rules—Number 23 and 28.
By-laws—V. No. 1, Library Committee.
VI. No. 3, Meetings of Society.
VII. Nos. 6 and 12, Papers.

Mr. Roach then moved, and Professor Prescott seconded, that the Rules and By-laws be adopted.—Carried.

Ordinary Meeting, September 10, 1931, at 8.5 p.m.

The Senior Vice-President (Professor T. Harvey Johnston) occupied the chair and 51 members and visitors were present.

Mr. B. S. Roach declared that he had read the Minutes of the Ordinary Meeting, held August 13, 1931, and could certify that they constituted a correct record, and moved that they be taken as read. Professor J. A. Prescott seconded the motion, which was carried.

Election of Fellows.—Oscar Westcott Frewin, M.B., B.S., medical practitioner, Hindmarsh, and John Matthew Dwyer, M.B., B.S., medical practitioner, Adelaide Hospital. A ballot was taken and Dr. Frewin and Dr. Dwyer were declared elected.

At 8.15 p.m. the Patron of the Society, His Excellency the Governor, Brig.-General the Hon. A. A. Hore-Ruthven, V.C., K.C.M.G., C.B., D.S.O., was warmly welcomed by the Chairman.

Professor T. Harvey Johnston expressed the delight of the Fellows at the presence of Sir Wm. Mitchell and Naval Lieut. K. Oom, who was cartographer on the "Discovery."

Professor Harvey Johnston extended a warm welcome to Lady Mawson, and then read letters of apology from Sir George Murray and Sir Joseph Verco.

The Chairman then addressed the members as follows:—

"Tonight the Royal Society of South Australia has met to offer one of its members the highest honour that it has in its power to confer, and by so doing feels that it is also honouring itself by adding so illustrious a name as that of Sir Douglas Mawson to its roll of the recipients of the Verco Medal. This award, which commemorates the name of Sir Joseph Verco who devoted so much of his time, talent, and substance to furthering the interests of our Society, has been bestowed twice previously, namely, to our veteran geologist, Professor W. Howchin, and to our distinguished botanist, Mr. J. M. Black.

"The absence of our President who is on a visit to England to attend the meeting of the British Science Association, has placed on me, as Senior Vice-

President, the duty of eulogizing Sir Douglas Mawson before I call upon His Excellency to make the presentation. It is perhaps appropriate that this privilege has fallen on me, firstly because I have known Sir Douglas for a longer period than most of the members, since we were fellow-students in Science in Sydney University twenty-seven years ago; secondly, because we are colleagues in the University of Adelaide; thirdly, because it has been my privilege to accompany him as a member of the two recent expeditions to the Antarctic in the 'Discovery,' and to visit with him the scene of some of his former hardships and triumphs.

"Mawson's fame as an explorer and geographer is so great that one is apt to overlook his fine record of physical, geological, and mineralogical research work. Our Memoirs and Transactions for the past quarter of a century contain many of his papers relating to the structure of Central and South Australia, while numerous papers have appeared in British and American Journals. His earliest expedition was one to study the geology of the New Hebrides, in 1903. Soon afterwards he was appointed to the geological staff of the Adelaide University. His first experience of polar conditions was obtained as a member of Shackleton's British Antarctic Expedition (1907-9) in which, in company with his teacher, Professor (now Sir Edgeworth) David (also a member of our Society), and Dr. Mackay, he made the first ascent of Mount Erebus (13,350 feet), and, later, discovered the South Magnetic Pole, the accounts of these two journeys, as given in 'The Heart of the Antarctic,' making thrilling reading. Dr. H. R. Mill, in his 'Life of Sir Ernest Shackleton,' in referring to the work of David and Mawson on those occasions, said that they 'proved themselves to be worthy to rank with the foremost polar explorers of all time.' Professor David, in his account of the South Magnetic Polar journey, wrote of Mawson:—'He had throughout the whole journey showed excellent capacity for leadership, fully justifying the opinion held of him by Lieut. Shackleton when providing in my instructions from him that, in the event of anything happening to myself, Mawson was to assume leadership.'

"The experience gained in that expedition was fully utilized when Mawson planned the Australian Antarctic Expedition which carried out such excellent work during the years 1911 to 1914, contemporaneously with the last Scott ('Terra Nova') Expedition and Amundsen's bold dash to the South Pole. Gordon Hayes, in his book 'Antarctica,' makes frequent reference to the character and work of Mawson's Expedition, and I take the liberty of quoting his words. He stressed the fact that seventeen University men were included in the personnel of 'the finest expedition that ever sailed to either of the polar regions.' '. . . . The British were only feeling their way into Antarctica and serving their novitiate in its exploration until Sir Douglas Mawson's Expedition.' 'Mawson's Expedition may be held up . . . as a model for others to copy.' Its excellence lay in its design, its scope and its executive success; and it owes its exalted position amongst other expeditions mainly to the fact that it was originated and conducted by scientists of administrative ability.' . . . 'The results of Mawson's Expedition bear a closer resemblance to the splendid pioneering of Admiral Ross than that of any other Antarctic Exploration.' 'Mawson's results far exceed all others (*i.e.*, Amundsen's, Scott's two, Shackleton's) because he made the greatest inroad into the unknown with the finest scientific staff. . . . No other expedition equals the Australasian one in the wealth and importance of the data collected and in results generally.' No less than 1,500 miles of coast line were discovered in the windiest country in the world, aptly termed 'The Home of the Blizzard.' New seas were explored and huge biological and geological collections made.

"His tragic experiences in his far eastern journey, so simply told in his diary and recorded in his book, are known to all of us—the loss of Ninnis and most of the dogs and food down an enormous crevasse, and then the death of Mertz, and

the long, dangerous, solitary journey which led Mawson back, worn and starved, to safety just in time to see the relief ship disappearing in the distance. Hayes, in referring to Mawson's action regarding Mertz, says, 'This is one of the finest examples of heroism that even the exploration of Antarctica has produced.' . . . 'The moral effect of this second fatality must have been dreadful. One Antarctic explorer told the author that he was doubtful whether any other man but Mawson would have survived the ordeal. Nearly every factor of hardship incidental to polar travel had to be endured. . . . His only hope was that if he could get near enough to the Base, his diary might be discovered with his body, and thus the discoveries made by his party would not be lost.'

"During the last 'Discovery' Expedition we visited Cape Denison, and as I stood at the foot of the cross and read the inscription: 'Erected to commemorate the supreme sacrifice made by Lieut. B. E. S. Ninnis and Dr. X. Mertz in the cause of Science. A. A. E., 1913,' I tried to imagine what the feelings of Sir Douglas must have been as past events recalled themselves to his memory during the few days of our sojourn in that blizzard-swept region.

"The call of the 'Great White South' was responded to again, and after years of preparatory work, the B.A.N.Z.A.R.E. (British, Australian and New Zealand Antarctic Research Expedition) was launched, Scott's old ship, the 'Discovery,' being made available for extensive exploration and oceanographic work in the Antarctic and Subantarctic. I believe that the results, when published, will indicate that the two voyages, 1929-1930 and 1930-31, have resulted in the exploration of a much greater length of the Antarctic coastline and a more intensive oceanographic study of the two Antarctic waters than has been accomplished by any other expedition to date, and the credit of this is due, primarily, to Sir Douglas Mawson's leadership, organising ability, wide experience, his knowledge of men, and his appreciation of scientific team work. He has received many well-deserved honours. His Majesty has conferred on him Knighthood as well as the O.B.E., and the Polar Medal (with two bars). He has also received the Order of the Crown of Italy, and the Order of St. Maurice and St. Lazarus, another Italian decoration. The Royal Society of London elected him a F.R.S. The Royal Geographic Society of London awarded him a special medal struck for the Shackleton Expedition, and in 1914 the Founder's Medal for his work in the Australian Expedition.

"Other medals awarded to him for his geographical and geological work, were the Livingstone Medal of the American Geographical Society; the Helen Cuver Medal of the Chicago Geographical Society; the gold medal of the Geographical Society of Paris; the Nachtigal Medal of the Berlin Geographical Society; the Bigsby Medal of the Geological Society of London (for general geological research work); the Mueller Memorial Medal of the Australasian Association for the Advancement of Science; the Founder's Medal of the Royal Geographical Society of Australia (Queensland Branch); and now our Society desires to add the Sir Joseph Verco Medal for research to the other nine already received by our distinguished Past President, Professor Sir Douglas Mawson, who, we all hope, will live long to enjoy his well-earned distinctions and to pursue with unabated zeal his researches into the hidden mysteries of Nature and Science.

"I have much pleasure in inviting our esteemed Patron, His Excellency the Governor, to make the presentation on behalf of the members of the Royal Society of South Australia."

His Excellency the Governor, on presenting the medal to Sir Douglas Mawson, paid a glowing tribute to his qualifications as a Leader of Men, and as a Scientist.

Sir Douglas Mawson, in acknowledging the medal, said he was deeply sensible of the honour conferred on him. He stressed the importance of having

the right men on the expeditions, and said the success of the expeditions was due to the type of men who made the voyage.

Mr. N. B. Tindale exhibited a series of seventeen plaster casts of faces and busts of Central Australian aborigines. The impressions for these were made by Mr. H. M. Hale and himself at Cockatoo Creek, 150 miles north-west of Alice Springs, during the Adelaide University and Museum Anthropological Expedition, August, 1931. Members of both sexes of the Ilpirra, Anmatjera, Ngalia, and Aranda tribes, between the approximate ages of 12 and 65 years, were represented. The bush natives proved to be excellent subjects, and displayed marked self-control and confidence throughout the operations. The methods employed are similar to those practiced by Dr. V. Suk, of Czeco-Slovakia, and others; the eyes remaining open during the whole proceedings. Improvements in technique have been devised which permit the obtaining of a complete mould of both sides of the face and neck in one operation. The data obtained during the anthropometric examinations enable the eyes and skin colour to be matched in the completed casts. Professor Cleland, Dr. Campbell, and the Chairman took part in the discussion which followed.

Papers—

"The Dead Rivers of South Australia, Part I., The Western Group," by Professor Walter Howchin, F.G.S., who illustrated his remarks with maps and diagrams. Sir Douglas Mawson, Mr. Madigan, and Dr. Chewings discussed Professor Howchin's paper. The Chairman extended the thanks of those present to Professor Howchin for his interesting remarks.

"The Mammals of the Dawson Valley, Queensland, Part I.," by H. H. Finlayson. It was moved by Professor J. A. Prescott, seconded by Mr. B. S. Roach, that the paper be taken as read.

Annual Meeting, October 8, 1931.

The Senior Vice-President (Professor T. Harvey Johnston) occupied the Chair and 42 members and visitors were present.

Minutes of the Special and Ordinary Meetings, held September 10, 1931, were read and confirmed.

Mr. B. S. Roach referred to the loss sustained by the death of Sir John Monash and moved that a wreath and the following telegram be sent: "With the deepest sympathy and in admiration for the career of a great Australian citizen, renowned in war and distinguished in applied science. This wreath is forwarded by the Royal Society of South Australia." The motion was seconded by Dr. L. Keith Ward and carried by the Fellows standing in silence for a few minutes.

The Chairman heartily congratulated Professor J. A. Prescott on behalf of the Fellows on having been awarded the Henry George Smith Medal by the Australian Chemical Institute for his researches in Applied Chemistry.

The Secretary read the Annual Report of the Council for the year ended September 30th, 1931. It was moved by Mr. Selway, seconded by Professor Cleland, that the Report be received and adopted.—Carried

The Treasurer presented the Financial Statement for the year ended September 30, 1931, and moved that it be received and adopted. Seconded by Mr. Selway and carried.

The Chairman extended a welcome to Dr. John M. Dwyer as a new Fellow.

The Chairman then drew attention to the valuable services rendered to the Society by the Honorary Editor, Treasurer, and Secretary.

Professor Prescott moved, and Mr. Bailey seconded, that the appreciation of the Fellows for the services rendered by those Officers be recorded in the Minutes.—Carried.

The following Officers and Members of Council were elected for the year 1931-32:—President, Professor T. Harvey Johnston, M.A., D.Sc.; Vice-Presidents, Professor J. A. Prescott, M.Sc., A.I.C., and Mr. J. M. Black; Editor, Professor Walter Howchin, F.G.S.; Treasurer, B. S. Roach; Secretary, Ralph W. Segnit, M.A., B.Sc.; Members of Council, Sir Joseph C. Verco, M.D., F.R.C.S., T. D. Campbell, D.D.Sc., Herbert M. Hale; Auditors, W. C. Hackett and O. Glastonbury.

Papers—

"Pollination of *Caladenia deformis* R. Br.," by R. S. Rogers, M.A., M.D.

"Additions to the Flora of South Australia, No. 29," by J. M. Black.

"Australian Fungi, Notes and Descriptions, No. 8," by Professor J. B. Cleland, M.D.

"Notes on Some South and Central Australian Mammals, Part II.," by H. H. Finlayson.

"Pelecypoda obtained from the Abattoirs Bore," by Nelly Hooper Woods, M.A.

"Petrographic Notes on Some Basic Rocks from the Mount Barker and Woodside Districts," by A. R. Alderman, M.Sc., F.G.S.

Exhibits.—Dr. L. Keith Ward exhibited "Widmanstatten" Figures on the Henbury Meteoric Iron, and said that when a polished surface of a meteoric iron is etched by immersion for a few minutes in dilute nitric acid, markings are produced which are named after the German chemist who first brought them to notice. The markings are composed of interlocking plates of nickel-iron alloys, known as kamacite—and taenite, with the interstices filled by an entectic mixture termed plessite. The proportion of iron to nickel in kamacite ranges from 13:1 to 18:1, and in taenite from 1:1 to 7:1. The "Widmanstatten" figures are the result of the differences in the solubility of the alloys in acid. Mr. A. G. Edquist exhibited some wattle seedlings of the species *Acacia decurrens* grown from seeds that had been boiled for various times, extending from 25 to 40 minutes.

ANNUAL REPORT

For the Year ended September 30, 1931.

The average attendance of Fellows at the meetings held during the year has been 36.

The Patron of the Society, His Excellency the Governor Brig.-General the Hon. A. A. Hore-Ruthven, V.C., K.C.M.G., C.B., D.S.O., paid an official visit to the Society at the Ordinary Meeting held in September.

The President, Dr. Charles A. E. Fenner, left Australia for England early in August to attend the Centenary Meeting of the British Association for the Advancement of Science, and the Clerk Maxwell Celebrations at Cambridge, as the Representative Delegate of this Society, and the best wishes of the Fellows were extended to him for a happy and successful voyage.

The Senior Vice-President, Professor T. Harvey Johnston, and on one occasion the Junior Vice-President, Professor J. A. Prescott, acted as Chairmen during the absence of the President.

Professor Sir Douglas Mawson, a past President of the Society, was awarded the Sir Joseph Verco Medal for 1931, which was handed to him by the Patron.

Professor Walter Howchin received the congratulations of the Society on the completion and publication of Part III., "The Building of Australia and the Succession of Life."

Professor Sir Douglas Mawson and Professor T. Harvey Johnston were welcomed and congratulated by the Society on their safe return from the second phase of the Antarctic Expedition.

Professor Kerr Grant was elected as the Representative of the Society to the Faraday Celebrations at Cambridge.

Dr. A. Lewis was elected as the Representative Delegate of the Society to the 400th Centenary Celebrations of the College of France at Paris.

Sir William Bragg, an Honorary Fellow of the Society, received the congratulations of the Fellows on having had the distinguished honour of the Order of Merit conferred upon him.

Sir Horace Lamb, a past President of the Society, was congratulated on having had the distinction of Knighthood conferred upon him.

During the year two of the Ordinary Meetings of the Society were devoted to special subjects in the form of a series of lectures, which were largely attended. The first was a "General Discussion on Laterite and Lateritic Soils," introduced by Professor J. A. Prescott, who was assisted by Mr. R. J. Best, Mr. J. G. Wood, Mr. C. T. Madigan, and Dr. R. Lockhart Jack. The second consisted of a series of lecturettes on "The Status of the Native Flora of South Australia," at which the following Fellows contributed short lectures:—Mr. J. M. Black, Dr. R. S. Rogers, Mr. J. F. Bailey, Mr. J. G. Wood, Dr. Robert Pulleine, and Professor J. B. Cleland.

At the Ordinary Meeting held in August, Mr. Edwin Ashby delivered an interesting lecture on "The Evolution of Chitons."

During the year the Rules and By-laws of the Society have been revised and amended.

Papers:—

Geological papers were contributed by Dr. Chas. Chewings, Mr. N. B. Tindale, Professor Walter Howchin, Mr. A. R. Alderman, and Miss N. H. Woods.

Zoological papers were read by Mrs. Effie W. Best, Mr. Arthur M. Lea, and Mr. H. H. Finlayson.

Botanical papers were presented by Miss B. Jean Murray (communicated by Mr. J. G. Wood), Dr. R. S. Rogers, Mr. J. M. Black, and Prof. J. B. Cleland.

Two Anthropological papers were read by Dr. H. K. Fry.

A Meteorological paper was contributed by Professor J. A. Prescott.

The Membership of the Society shows a slight increase, the number of Fellows elected during the year being 11. Seven Fellows resigned, and one died. The Membership roll at the close of the year is as follows:—Honorary Fellows, 5; Fellows, 166; Associates, 1. Total, 172.

During the year the Society has suffered loss by death of one Fellow, namely, Dr. Thomas James, who was elected a Fellow in 1893.

The Council has met on 12 occasions, of which 3 were special meetings, the attendance being as follows:—

Dr. Charles Fenner, 9; Professor T. Harvey Johnston, 8; Professor J. A. Prescott, 7; Mr. Ralph W. Segnit, 12; Mr. B. S. Roach, 12; Professor Walter Howchin, 12; Sir Joseph C. Verco, 0; Dr. T. D. Campbell, 7; Mr. J. M. Black, 9; Mr. J. F. Bailey, 11; Mr. Arthur M. Lea, 11; Mr. C. T. Madigan, 7.

The President was absent from two meetings whilst attending Science celebrations in England as a Representative Delegate of this Society. Professor T. Harvey Johnston was away from two meetings, due to his absence from the State in connection with the Antarctic Expedition, and was in the interior of Australia

during the August meeting. Professor J. A. Prescott was granted leave of absence from three meetings to attend Science meetings in Melbourne and Tasmania. Dr. T. D. Campbell was in the interior of Australia during the August meeting. Mr. J. M. Black was granted leave of absence from two meetings to visit England and the Continent. Mr. J. F. Bailey was granted leave of absence in March to visit Victoria. Mr. C. T. Madigan was absent from two meetings whilst in Central Australia.

CHAS. A. E. FENNER, *President.*
RALPH W. SEGNIT, *Secretary.*

THE SIR JOSEPH VERCO MEDAL.

The Council, on August 23, 1928, having resolved to recommend to the Fellows of the Society that a medal should be founded to give honorary distinction for scientific research, and that it should be designated the Sir Joseph Verco Medal, was submitted to the Society at the evening meeting of October 11, 1928,

and at a later meeting, held on November 8, 1928, when the recommendation of the Council was confirmed on the following terms:—

REGULATIONS.

XI.—The medal shall be of bronze, and shall be known as the Sir Joseph Verco Medal, in recognition of the important service that gentleman has rendered to the Royal Society of South Australia. On the obverse side of the medal shall be these words: 'The Sir Joseph Verco Medal of the Royal Society of South Australia,' surrounding the modelled portrait of Sir Joseph Verco, while on the reverse side of the medal there shall be a surrounding wreath of eucalypt, with the words: 'Awarded to...for Research in Science,' the name of the recipient, and the year of the award. The Council shall select the person to whom it is suggested that the medal shall be awarded, and that name shall be submitted to the Fellows at an Ordinary Meeting to confirm, or otherwise, the selection of the Council, by ballot or show of hands. The medal shall be awarded for distinguished scientific work published by a Member of the Royal Society of South Australia."

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments for the Year ended September 30, 1931.

RECEIPTS.

	£ s. d.	£ s. d.
To Balance, October 1, 1930		743 12 6
,, Subscriptions	152 10 0	
,, Field Naturalists' Section	32 0 0	
		184 10 0
,, Use of Room and Lantern by other Societies	6 9 6	
,, Sale of Publications and Exchange	10 8 2	
		16 17 8
,, Interest—		
Savings Bank Account	28 19 7	
Transferred from Endowment Fund	184 2 2	
		213 1 9
		£1,158 1 11

PAYMENTS.

	£ s. d.	£ s. d.
By Transactions—		
Printing	214 11 8	
Illustrating	51 15 1	
Publishing	10 0 4	
		276 7 1
,, Library—		
Librarian	41 12 6	
Customs Duties	9 0 0	
		50 12 6
,, Sundries—		
Cleaning and Lighting	8 16 8	
Printing, Postages and Stationery	21 10 2	
Insurance	6 15 0	
		37 1 10
,, Grant to Field Naturalists' Section		65 15 0
,, Balance, September 30, 1931—		
Savings Bank of South Australia	617 13 8	
The Bank of Australasia	110 11 10	
		728 5 6
		£1,158 1 11

Audited and found correct,

W. CHAMPION HACKETT } Hon.
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 3, 1931.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

ENDOWMENT FUND.

As at September 30, 1931.

(Capital £4,069 6 10d.)

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
1930—October 1.			1931—September 30.		
To Balance, S.A. Government Stock	4,064 18 9		By Revenue Account		184 2 2
Savings Bank	4 8 1		„ S.A. Government Inscribed Stock at Cost	4,064 18 9	
		4,069 6 10	„ Savings Bank Account	4 8 1	
„ Interest Received		184 2 2			4,069 6 10
		£4,253 9 0			£4,253 9 0

Application has been made to convert the S.A. Government Stock into the National Debt Conversion Loan.

Audited and found correct,

W. CHAMPION HACKETT } Hon.
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 3, 1931.

THE ENDOWMENT AND SCIENTIFIC RESEARCH FUND.

1902.—On the motion of the late Samuel Dixon it was resolved that steps be taken for the incorporation of the Society and the establishment of an Endowment and Scientific Research Fund. Vol. xxvi., pp. 327-8.

1903.—The incorporation of the Society was duly effected and announced. Vol. xxvii., pp. 314-5.

1905.—The President (Dr. J. C. Verco) offered to give £1,000 to the Fund on certain conditions. Vol. xxix., p. 339.

1929.—The following are particulars of the contributions received and other sources of revenue in support of the Fund up to date:—

SUMMARY OF THE ENDOWMENT FUND.

(Capital £4,069 6s. 10d.)

Contributions.

	£ s. d.	£ s. d.	£ s. d.
Donations—			
1908, Dr. J. C. Verco	1,000 0 0		
1908, Thomas Scarfe	1,000 0 0		
1911, Dr. Verco	150 0 0		
1913, Dr. Verco	120 0 0		
Mrs. Ellen Peterswald	100 0 0		
Small Sums	6 0 0		
		2,376 0 0	
Bequests—			
1917, R. Barr Smith	1,005 16 8		
1920, Sir Edwin Smith	200 0 0		
		1,205 16 8	
Life Members' Subscriptions		225 0 0	
*Interest and Discounts		156 3 10	
From Current Account		106 6 4	
			4,069 6 10

*Interest on investments has, in the main, been transferred to general revenue for the publication of scientific papers. See Balance-sheets.

GRANTS MADE IN AID OF SCIENTIFIC RESEARCH.

1916, G. H. Hardy, "Investigations into the Flight of Birds"	15 0 0
1916, Miss H. A. Rennie, "Biology of *Lobelia gibbosa*"	2 2 0
1921, F. R. Marston, "Possibility of obtaining from Azine precipitate samples of pure Proteolytic Enzymes"	30 0 0
1921, Prof. Wood Jones, "Investigations of the Fauna and Flora of Nuyts Archipelago"	44 16 7

ROYAL SOCIETY LIBRARY.

List of Governments, Societies and Editors with whom Exchanges of Publications are made.

AUSTRALIA.

Australasian Institute of Mining and Metallurgy, Melbourne.
Bureau of Census and Statistics, Canberra.
Council for Scientific and Industrial Research, Melbourne.

SOUTH AUSTRALIA.

Botanic Garden, Adelaide.
Mines Department, Adelaide.
Public Library, Museum, and Art Gallery of South Australia.
Royal Geographical Society of Australasia (S.A. Branch).
South Australian Institutes Association, Adelaide.
South Australian Museum, Adelaide.
South Australian Naturalist, Adelaide.
South Australian Ornithologist, Adelaide.
South Australian Parliamentary Library.
University of Adelaide.
Waite Agricultural Research Institute, Glen Osmond.

NEW SOUTH WALES.

Australian Museum, Sydney.
Botanic Gardens, Sydney.
Department of Agriculture, Sydney.
Linnean Society of New South Wales.
Mines Department, Sydney.
Public Library of New South Wales.
Royal Society of New South Wales.
Royal Zoological Society of New South Wales.
School of Public Health and Tropical Medicine, Sydney.
Technological Museum, Sydney.
University of Sydney.

QUEENSLAND.

Department of Agriculture, Brisbane.
Geological Survey, Brisbane.
Queensland Museum, Brisbane.
Public Library of Queensland, Brisbane.
Royal Society of Queensland, Brisbane.
University of Queensland, Brisbane.

TASMANIA.

Government Geologist, Mines Department, Hobart.
Public Library of Tasmania, Hobart.
Royal Society of Tasmania, Hobart.
University of Tasmania, Hobart.

VICTORIA.

Field Naturalists' Club of Victoria, Melbourne.
Government Botanist, National Herbarium, Melbourne.
Mines Department, Melbourne.
National Museum, Melbourne.
Public Library of Victoria, Melbourne.
Royal Society of Victoria, Melbourne.
University of Melbourne.

WESTERN AUSTRALIA.

Geological Survey Department, Perth.
Public Library of Western Australia, Perth.
Royal Society of Western Australia, Perth.
University of Western Australia, Perth.

ENGLAND.

British Museum Library, London.
British Museum (Natural History), South Kensington.
Cambridge Philosophical Society.
Cambridge University Library.
Conchological Society of Great Britain and Ireland.
Entomological Society of London.
Geological Society of London.
Geologists' Association, London.
Hill Museum, Witley, Surrey.
Imperial Institute, South Kensington.
Imperial Institute of Entomology, London.
Linnean Society of London.
Liverpool Biological Society.
Manchester Literary and Philosophical Society.
National Physical Laboratory, Teddington.
Rhodes House Library, Oxford.
Rothamsted Experimental Station, Harpenden.
Royal Botanic Gardens, Kew.
Royal Empire Society, London.
Royal Geographical Society, London.
Royal Microscopical Society, London.
Royal Society, London.
Science Museum, South Kensington.
Zoological Museum, Tring, Herts.
Zoological Society of London.

SCOTLAND.

Edinburgh Geological Society.
Geological Society of Glasgow.
Royal Society of Edinburgh.

IRELAND.

Royal Dublin Society.
Royal Irish Academy, Dublin.

AUSTRIA.

Akademie der Wissenschaften, Vienna.
Geologische Bundesanstalt, Vienna.
Naturhistorische Museums, Vienna.
Zoologisch-Botanische Gesellschaft, Vienna.

BELGIUM.

Académie Royale de Belgique, Brussels.
Instituts Solvay, Brussels.
Musée Royale d'Histoire Naturelle de Belgique, Brussels.
Société Entomologique de Belgique, Ghent.
Société Royale de Botanique de Belgique, Brussels.
Société Royale des Sciences de Liège.
Société Royale Zoologique de Belgique, Brussels.

BRAZIL.

Instituto Oswaldo Cruz, Rio de Janeiro.
Museu Paulista, Sao Paulo.

CANADA.

Canadian Geological Survey, Ottawa.
National Research Council of Canada, Ottawa.
Nova Scotian Institute of Science, Halifax.
Royal Canadian Institute, Toronto.
Royal Society of Canada, Ottawa.
University of British Columbia, Vancouver.

CHINA.

Geological Survey of China, Peiping.
Institute of Biology, National Library of Peiping.

CZECHO-SLOVAKIA.

Ceskoslovenska Botanicka Spolecnost, Prague.

DENMARK.

Conseil Permanent International pour l'Exploration de la Mer.
Danske Naturhistorisk Forening. Copenhagen.
Kobenhavn Universitets Zoologiske Museum.
K. Danske Videnskabernes Selskabs. Copenhagen.

FINLAND.

Societas Entomologica Helsingforsiensis.
Societas Scientiarum Fennica, Helsingfors.

FRANCE.

Muséum National d'Histoire Naturelle, Paris.
Société des Sciences Naturelles de l'Ouest de la France, Nantes.
Société Entomologique de France, Paris.
Société Géologique de France, Paris.
Société Linnéenne de Bordeaux.
Societe Linnéenne de Normandie, Caen.

GERMANY.

Bayerische Akademie der Wissenschaften zu München.
Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte.
Bibliothek der Botanischen Gartens und Museums, Berlin.
Fedde, F.: Repertorium specierum novarum regni vegetabilis, Berlin.
Gesellschaft der Wissenschaften zu Göttingen.
Gesellschaft für Erdkunde zu Berlin.
K. Leopoldinische Deutsche Akademie de Naturforscher, Halle.
Naturforschende Gesellschaft, Freiburg.
Preussische Akademie der Wissenschaften, Berlin.
Senckenbergische Bibliothek, Frankfürt a. M.
Zoologische Museum der Universitat, Berlin.
Zoologische Staatsinstitut und Zoologische Museum, Hamburg.

HAWAIIAN ISLANDS.

Bernice Pauahi Bishop Museum, Honolulu.
Hawaiian Entomological Society, Honolulu.

HOLLAND.

Musée Teyler, Harlem.
Rijks Herbarium, Leiden.

HUNGARY.

Musée National Hongrois, Budapest.

INDIA.

Colombo Museum.
Government Museum, Madras.
Geological Survey of India, Calcutta.
Royal Asiatic Society, Bombay Branch and Malayan Br.
Zoological Survey of India, Calcutta.

ITALY.

Laboratoria di Entomologia, Bologna.
Laboratoria di Zoologia Generale e Agraria, Portici.
Società di Scienze Naturali ed Economiche, Palermo.
Società Entomologica Italiana, Genova.
Società Italiana di Scienze Naturali, Milano.
Società Toscana di Scienze Naturali, Pisa.

JAPAN.

Hiroshima University.
Kyōto Imperial University.
Taihoku Imperial University.
Tokyo Imperial University.

MEXICO.

Instituto Geológico de Mexico.
Sociedad Cientifica "Antonio Alzate," Mexico.

NEW ZEALAND.

Auckland Institute and Museum.
Dominion Museum, Wellington.
New Zealand Institute, Wellington.
Otago University Museum, Dunedin.
Philosophical Institute of Canterbury, Christchurch.

NORWAY.

Bergens Museum, Bergen.
Kongelige Norske Videnskabers Selskabs, Trondheim.
Tromso Museum.

PHILIPPINE ISLANDS.

Philippine Journal of Science, Manila.

POLAND.

Société Botanique de Pologne, Warszawa.
Société Polonaise des Naturalistes "Kopernik," Lwow.

RUSSIA.

Academie of Sciences, Leningrad.
Comité Géologique de Russie, Leningrade.

SPAIN.

Instituto Nacional de Segunda Ensenanza de Valencia.
Real Academia de Ciencias y Artes, Barcelona.

SWEDEN.

Entomologiska Föreningen i Stockholm.
Geologiska Föreningen, Stockholm.
Stockholm's Högskolas Bibliotek, Stockholm.
Regia Societas Scientiarum Upsaliensis, Upsala.

SWITZERLAND.

Naturforschende Gesellschaft, Basel.
Société de Physique et d'Histoire Naturelle de Genève.
Société Neuchâteloise des Sciences Naturelles, Neuchâtel.
Société Vaudoise des Sciences Naturelles, Lausanne.
Zentralbibliothek, Zürich.

UNION OF SOUTH AFRICA.

Albany Museum, Grahamstown.
Geological Society of South Africa, Johannesburg.
Royal Society of South Africa, Cape Town.
South African Museum, Cape Town.
South African Association for the Advancement of Science, Johannesburg.

UNITED STATES.

Academy of Natural Sciences of Philadelphia.
Academy of Science of St. Louis.
American Academy of Arts and Sciences, Boston.
American Chemical Society, Columbus, O.
American Geographical Society, New York.
American Microscopical Society, Manhattan, Kans.
American Museum of Natural History, New York.
American Philosophical Society, Philadelphia.
Arnold Arboretum, Jamaica Plain, Mass.
Biological Survey of the Mount Desert Region, Bar Harbour, Me.
Boston Society of Natural History, Boston, Mass.
Brooklyn Institute of Arts and Sciences.
California Academy of Sciences, San Francisco.
Californian State Mining Bureau, San Francisco.
California, University of, Berkeley, Cal.
Chicago Academy of Sciences.
Citrus Experiment Station, Riverside, Cal.
Connecticut State Library, Hartford, Conn.
Cornell University, Ithaca, N.Y.
Denison Scientific Association, Granville, O.
Field Museum of Natural History, Chicago, Ill.
Franklin Institute of the State of Pennsylvania, Philad.
Harvard Museum of Comparative Zoology, Cambridge, Mass.
Illinois State Natural History Survey, Urbana, Ill.
Illinois University Library, Urbana, Ill.
Indiana Academy of Science, Indianapolis.
Johns Hopkins University, Baltimore, Md.
Kansas University, Lawrence, Kans.
Marine Biological Laboratory, Wood's Hole, Mass.
Maryland Geological Survey, Baltimore, Md.
Michigan University, Chicago.
Missouri Botanical Garden Library, St. Louis, Mo.
National Academy of Science, Washington, D.C.
National Geographic Society, Washnigton, D.C.
New York Academy of Sciences, New York.
New York Public Library.
New York State Library, Albany, N.Y.
North Carolina Geological and Economic Survey, Chapel Hill.
Ohio State University Library, Columbus, O.
San Diego Society of Natural History, San Diego, Cal.
Smithsonian Institution and Bureau of Ethnology, Washington.
United States Department of Agriculture, Washington, D.C.
United States Geological Survey, Washington, D.C.
United States National Museum, Washington, D.C.
Wagner Free Institute of Science, Philadelphia, Pa.
Washington University, St. Louis, Mo.
Yale University Library, New Haven, Conn.

URUGUAY.

Museo de Historia Natural de Montevideo.

LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1931.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrear.

Date of Election.

HONORARY FELLOWS.

1910. *BRAGG, SIR W. H., K.B.E., O.M., M.A., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
1926. *CHAPMAN, F., A.L.S., National Museum, Melbourne.
1897. *DAVID, SIR T. W. EDGEWORTH, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S., F.G.S., Emeritus Professor of Geology, University of Sydney, Coringah, Sherbroke Road, Hornsby, N.S.W.
1898. *MEYRICK, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *WILSON, J. T., M.D., Ch.M., F.R.S., Professor of Anatomy, Cambridge University, England.

FELLOWS.

1926. ABEL, L. M. Chapman Camp, British Columbia.
1925. ADEY, W. J., 32 High Street, Burnside, S.A.
1927. *ALDERMAN, A. R., M.Sc., F.G.S., West Terrace, Kensington Gardens, S.A.
1931. ANDREW, REV. J. R., Woodside.
1929. ANGEL FRANK M., Box 1327G, G.P.O., Adelaide.
1895. †*ASHBY, EDWIN, F.L.S., M.B.O.U., Blackwood, S.A.—**Council,** 1900-19; **Vice-President,** 1919-21.
1917. BAILEY, J. F., Director Botanic Gardens, S.A.—**Council,** 1928-.
1902. *BAKER, W. H., King's Park, S.A.
1926. BECK, B. B., 127 Fullarton Road, Myrtle Bank, S.A.
1928. BEST, R. J., M.Sc., A.A.C.I., Waite Agricultural Research Institute, Glen Osmond.
1928. *BEST, Mrs. E. W., M.Sc., Claremont, Glen Osmond.
1931. BIRCH, H. McI., M.R.C.S., M.R.C.P., Mental Hospital, Parkside.
1930. BIRKS, W. R., B.Sc., Principal, Roseworthy Agricultural College.
1907. *BLACK, J. M., 82 Brougham Place, North Adelaide—**Sir Joseph Verco Medal,** 1930; **Council,** 1927-1931. **Vice-President,** 1931-.
1924. BROWNE, J. W., B.Ch., 169 North Terrace, Adelaide.
1916. *BULL, LIONEL B., D.V.Sc., Laboratory, Adelaide Hospital.
1923. BURDON, ROY S., B.Sc., University of Adelaide.
1921. BURTON, R. J., Belair.
1922. *CAMPBELL, T. D., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road, Adelaide—**Council,** 1928-.
1907. *CHAPMAN, R. W., C.M.G., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University, Adelaide—**Council,** 1914-22.
1931. *CHEWINGS, CHAS., Ph.D., F.G.S., "Alverstroke," Glen Osmond.
1929. CHRISTIE, W., M.B., B.S., Education Department, Flinders Street, Adelaide.
1895. *CLELAND, JOHN B., M.D., Professor of Pathology, University, Adelaide—**Council,** 1921-26; **President,** 1927-28; **Vice-President,** 1926-27.
1930. COLLINS, F. V., B.V.Sc., Green Road, Woodville.
1930. COLQUHOUN, T. T., M.Sc., University, Adelaide.
1907. *COOKE, W. T., D.Sc., Lecturer, University of Adelaide.
1929. *COTTON, BERNARD C., S.A. Museum, Adelaide.
1924. DE CRESPIGNY, C. T. C., D.S.O., M.D., 219 North Terrace, Adelaide.
1916. DARLING, H. G., Franklin Street, Adelaide.
1929. DAVIDSON, JAMES, D.Sc., Waite Agricultural Research Institute, Glen Osmond.
1928. DAVIES, J. G., B.Sc., Ph. D., Waite Agricultural Research Institute, Glen Osmond.
1927. *DAVIES, Prof. E. HAROLD, Mus.Doc., The University, Adelaide.
1927. DAWSON, BERNARD, M.D., F.R.C.S., Otago University, Dunedin, New Zealand.
1930. DIX, E. V., Glynde Road, Firle.
1915. *DODD, ALAN P., Prickly Pear Laboratory, Sherwood, Brisbane.
1921. DUTTON, G. H., B.Sc., Agricultural High School. Murray Bridge.
1911. DUTTON, H. H., M.A., Anlaby, Kapunda.
1931. DWYER, J. M., M.B., B.S., Adelaide Hospital.
1902. *EDQUIST, A. G., 19 Farrell Street, Glenelg.

Date of Election.

1918. *Elston, A. H., F.E.S.. "Llandyssil," Aldgate.
1925. England, H. N., B.Sc., Commonwealth Research Station, Griffith, N.S.W.
1917. *Fenner, Chas. A. E., D.Sc., 42 Alexander Avenue, Rose Park—**Rep.-Governor,** 1929-; **Council,** 1925-28; **President,** 1930-31; **Vice-President,** 1928-30; **Secretary,** 1924-25
1927. *Finlayson, H. H., The University of Adelaide.
1929. Freney, M. Raphael, 14 Holden Street, Kensington Park.
1929. Freney, M. Richard, 14 Holden Street, Kensington Park.
1931. Frewin, O. W., M.B., B.S., Hindmarsh.
1923. *Fry, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside.
1930. Garrett, S. D., B.A., Waite Agricultural Research Institute, Glen Osmond.
1919. †Glastonbury, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. Glover, C. R. J., Stanley Street, North Adelaide.
1927. Godfrey, F. K., Robert Street, Payneham, S.A.
1904. Gordon, David, 72 Third Avenue, St. Peters.
1925. †Gosse, J. H., 31 Grenfell Street, Adelaide.
1880. *Goyder, George, A.M., B.Sc., F.G.S., 232 East Terrace, Adelaide.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University, Adelaide—**Council,** 1912-15.
1931. Gray, James T., Orroroo, S.A.
1904. Griffith, H., Hove, Brighton.
1916. Hackett, W. Champion, 35 Dequetteville Terrace, Kent Town.
1927. *Hackett, Dr. C. J., 196 Prospect Road, Prospect, S.A.
1922. *Hale, H. M., The Director, S.A. Museum, Adelaide—**Council,** 1931-.
1930. Hall, F. J., Adelaide Electric Supply Coy., Ltd., Adelaide.
1922. *Ham, William, F.R.E.S., 112 Edward Street, Norwood.
1916. †Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., A.Am.I.M.E., Bewdley, 66 Beresford Road, Bellevue Hill, Rose Bay, Sydney.
1924. Hawker, Captain C. A. S., M.H.R., M.A., North Bungaree, via Yacka, South Australia.
1896. Hawker, E. W., M.A., LL.B., F.C.S., East Bungaree, Clare.
1928. Hawker. M. S., Adelaide Club, North Terrace.
1923. Hill, Florence McCoy M., B.S., M.D., University of Adelaide.
1927. Holden, E. W., B.Sc., Dequetteville Terrace, Kent Town, S.A.
1929. Hosking, John W., 77 Sydenham Road, Norwood.
1930. Hosking, J. S., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1924. *Hossfeld, Paul S., M.Sc., Office of Home and Territories, Canberra.
1883. *Howchin, Professor Walter, F.G.S., "Stonycroft," Goodwood East—**Sir Joseph Verco Medal,** 1929; **Rep.-Governor,** 1901-22; **Council,** 1883-84, 1887-89, 1890-94, 1902-; **President,** 1894-96; **Vice-President,** 1884-87, 1889-90, 1896-1902; **Editor,** 1883-88, 1893-94, 1895-96, 1901-.
1928. Hurcombe, Miss J. C., 95 Unley Road, New Parkside.
1928. Ifould, Percy, Kurralta, Burnside.
1918. *Ising, Ernest H., c/o Superintendent's Office, S.A. Railways, Adelaide.
1918. *Jennison, Rev. J. C., 7 Frew Street, Fullarton Estate.
1910. *Johnson, E. A., M.D., M.R.C.S., Town Hall, Adelaide.
1921. *Johnston, Professor T. Harvey, M.A., D.Sc., University, Adelaide—**Rep.-Governor,** 1927-29; **Council,** 1926-28; **Vice-President,** 1928-31; **President,** 1931-.
1929. Johnston, W. C., Government Agricultural Inspector, Riverton.
1920. *Jones, Professor F. Wood, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., University, Melbourne—**Rep.-Governor,** 1922-27; **Council,** 1921-25; **President,** 1926-27; **Vice-President,** 1925-26.
1926. Julius, Edward, Conservator of Forests, Adelaide.
1918. Kimber, W. J., 28 Second Avenue, Joslin.
1915. *Laurie, D. F., Agricultural Department, Victoria Square.
1897. *Lea, A. M., F.E.S., S.A. Museum, Adelaide—**Council,** 1923-24, 1925-.
1884. Lendon, A. A., M.D., M.R.C.S., 66 Brougham Place, North Adelaide.
1922. Lendon, Guy A., M.B., B.S., M.R.C.P., North Terrace.
1925. Lewis, A., M.B., B.S., The Maudsley Hospital, Denmark Hill, London, S.E. 5.
1930. Louwyck, Rev, N. H., The Rectory, Yankalilla.
1922. *Madigan, C. T., M.A., B.Sc., F.G.S., University of Adelaide—**Council,** 1930-.
1923. Marshall, J. C.. Darrock, Payneham.
1928. Maegraith, B. J., M.B., B.S., Magdalen College, Oxford, England.
1929. Martin, F. C., B.A., Technical High School, Thebarton.
1931. Martin, Professor Sir Chas. J., Kt., C.M.G., D.Sc., University, Adelaide.
1905. *Mawson, Sir Douglas, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide **Sir Joseph Verco Medal,** 1931; **President,** 1924-25; **Vice-President,** 1923-24, 1925-26.
1919. Mayo, Helen M., M.D., 47 Melbourne Street, North Adelaide.
1920. Mayo, Herbert, LL.B., K.C., 16 Pirie Street, Adelaide.

Date of Election.

1929. McLaughlin, Eugene, M.B., B.S., M.R.C.P., Adelaide Hospital.
1929. McLaughlin, Eugene, M.B., B.S., M.R.C.P., Adelaide Hospital.
1907. Melrose, Robert T., Mount Pleasant.
1928. Melville, L. G., B.Ec., F.I.A., Professor of Economics, University of Adelaide, Adelaide.
1924. Messent, P. S., M.B., B.S., 192 North Terrace.
1930. Miller, J. I., C.E., 18 Ralston Street, Largs Bay.
1925. †Mitchell, Professor Sir William, K.C.M.G., M.A., D.Sc., The University, Adelaide.
1930. Mitchell, Miss U. H., B.Sc., Presbyterian Girls' College, Glen Osmond.
1897. *Morgan, A. M., M.B., Ch.B., 215 Brougham Place, North Adelaide.
1924. Morison, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1930. Morris, L. G., Beehive Buildings, King William Street, Adelaide.
1921. Moulden, Owen M., M.B., B.S., Unley Road, Unley.
1925. †Murray, Hon. Sir George, K.C.M.G., B.A., LL.M., Magill, S.A.
1925. North, Rev. Wm. O., Methodist Manse, Netherby.
1930. Ockenden, G. P., 11 Ailsa Street, Fullarton Estate.
1913. *Osborn, T. G. B., D.Sc., Professor of Botany, University, Sydney—**Council**, 1915-20, 1922-24; **President**, 1925-26; **Vice-President**, 1924-25, 1926-27.
1927. Paltridge, T. B., B.Sc., Koonamore, via Waukaringa, S.A
1929. Pank, Harold G., 75 Rundle Street, Adelaide.
1929. Paull, Alec. G., B.A., B.Sc., 10 Milton Avenue, Fullarton Estate.
1924. Pearce, C., Happy Valley Reservoir, O'Halloran Hill.
1927. Pennycuick, S. W., D.Sc., The University of Adelaide.
1924. Perkins, A. J., Director of Agriculture, Victoria Square.
1928. Phipps, Ivan F., Ph.D., Waite Agricultural Research Institute, Glen Osmond.
1926. *Piper, C. S., M.Sc., Waite Agricultural Research Institute, Glen Osmond.
1925. *Prescott, Professor J. A., M.Sc., A.I.C., Waite Agricultural Research Institute, Glen Osmond—**Council**, 1927-30; **Vice-President**, 1930-.
1926. Price, A. Grenfell, M.A., F.R.G.S., St. Mark's College, North Adelaide.
1907. †*Pulleine, Robert H., M.B., Ch.M., North Terrace, Adelaide—**Council**, 1914-19; **President**, 1922-24; **Vice-President**, 1912-14, 1919-22, 1924-25; **Secretary**, 1909-12, 1925-30.
1925. Richardson, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond, S.A.
1926. *Riddell, P. D., Technical College, Newcastle, N.S.W.
1911. Roach, B. S., 81 Kent Terrace, Kent Town—**Treasurer**, 1920-.
1924. Roeger, Miss M. T. P., c/o Central School, Goodwood.
1925. Rogers, L. S., B.D.Sc., 192 North Terrace.
1905. *Rogers, R. S., M.A., M.D., 52 Hutt Street, Adelaide—**Council**, 1907-14, 1919-21; **President**, 1921-22; **Vice-President**, 1914-19, 1922-24.
1931. Rudd, E. A., 10 Church Street, Highgate.
1922. *Samuel, Geoffrey, M.Sc., University of Adelaide.
1928. Scott, A. E., B.Sc., 143 Rundle Street, Kent Town.
1924. *Segnit, Ralph W., M.A., B.Sc., Assistant Government Geologist, Flinders Street, Adelaide—**Secretary**, 1930-.
1891. Selway, W. H., 14 Frederick Street, Gilberton—**Council**, 1893-1909.
1926. *Sheard, Harold, Nuriootpa.
1928. Showell, H., 27 Dutton Terrace, Medindie.
1920. Simpson, A. A., C.M.G., C.B.E., F.R.G.S., Lockwood Road, Burnside.
1924. Simpson, Fred. N., Dequetteville Terrace, Kent Town.
1925. †Smith, T. E. Barr, B.A., 25 Currie Street, Adelaide.
1927. Stapleton, P. S., Henley Beach, South Australia.
1922. Sutton, J., Fullarton Road, Netherby.
1925. Symons, Ivor G., Church Street, Highgate.
1929. *Taylor, John K., B.A., M.Sc., Waite Agricutural Research Institute, Glen Osmond.
1929. Tee, Sidney F., Adelaide Hospital.
1923. *Thomas, R. G., B.Sc., 5 Trinity Street, St. Peters, S.A.
1923. *Tindale, N. B., South Australian Museum, Adelaide.
1894. *Turner, A. Jefferis, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1925. Turner, Dudley C., National Chambers, King William Street, Adelaide.
1878. *Verco, Sir Joseph C., M.D., F.R.C.S., North Terrace, Adelaide—**Council**, 1924-; **President**, 1903-21; **Vice-President**, 1921-23.
1926. Wainwright, J. W., B.A., 32 Florence Street, Fullarton Estate.
1924. Walker, W. D., M.B., B.S., B.Sc., c/o National Bank, King William Street.
1929. Walters. Lance S., 157 Buxton Street, North Adelaide.
1912. *Ward, L. Keith, B.A., B.E., D.Sc., Govt. Geologist, Flinders Street, Adelaide—**Council**, 1924-27; **President**, 1928-30; **Vice-President**, 1927-28.
1920. Weidenbach, W. W., A.S.A.S.M., Geological Department, Adelaide.

Date of Election.	
1930.	Whitelaw, A. J., Norwood High School, Kensington.
1930.	Wilkinson, Professor H. J., B.A., Ch.M., M.D., University, Adelaide.
1931.	Wilson, Chas. E. C., M.B., B.S., "Woodfield," Fisher Street, Fullarton.
1920.	*Wilton, Professor J. R., D.Sc., University of Adelaide.
1923.	*Wood, J. G., M.Sc., University of Adelaide.
1927.	Woodlands, Harold, Box 989 H, G.P.O.
1931.	*Woods, Miss N. H., M.A., Mount Torrens.
1927.	*Woollard, Professor H. H., M.D., University of Adelaide.

Associate.

1929.	Cleland, W. Paton, 31 Wattle Street, Fullarton.

PAST AND PRESENT OFFICERS OF THE SOCIETY.

PRESIDENTS.

1877-79	Prof. Ralph Tate, F.G.S., F.L.S.
1879-81	Chief Justice [Sir] S. J. Way.
1881-82	[Sir] Charles Todd, C.M.G., F.R.A.S.
1882-83	H. T. Whittell, M.A., M.D., F.R.M.S.
1883-84	Prof. H. Lamb, M.A., F.R.S.
1884-85	H. E. Mais, M.I.C.E.
1885-88	Prof. E. H. Rennie, M.A., D.Sc., F.C.S.
1888-89	[Sir] Edward C. Stirling, C.M.G., M.A., M.D. (Cantab.), F.R.C.S., F.R.S.
1889-91	Rev. Thomas Blackburn, B.A.
1891-94	Prof. Ralph Tate, F.G.S., F.L.S.
1894-96	Prof. Walter Howchin, F.G.S.
1896-99	W. L. Cleland, M.B.
1899-03	Prof. E. H. Rennie, M.A., D.Sc., F.C.S.
1903-21	Sir Joseph C. Verco, M.D., F.R.C.S.
1921-22	R. S. Rogers, M.A., M.D.
1922-24	R. H. Pulleine, M.B., Ch.M.
1924-25	Sir Douglas Mawson, D.Sc., B.E., F.R.S.
1925-26	Prof. T. G. B. Osborn, D.Sc.
1926-27	Prof. F. Wood Jones, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S.
1927-28	Prof. John B. Cleland, M.D.
1928-30	L. Keith Ward, B.A., B.E., D.Sc., F.G.S.A.
1930-31	C. A. E. Fenner, D.Sc.
1931-	Prof. T. Harvey Johnston, M.A., D.Sc.

SECRETARIES.

1877	W. C. M. Finniss.
1877-81	Walter Rutt, C.E.
1881-92	W. L. Cleland, M.B.
1892-93	W. C. Grasby.
1893-94	W. B. Poole.
1894-95	W. L. Cleland, M.B. W. B. Poole.
1895-96	W. L. Cleland, M.B.
1896-09	G. G. Mayo, C.E.
1909-12	R. H. Pulleine, M.B., Ch.M.
1912-24	Walter Rutt, C.E.
1924-25	Chas. Fenner, D.Sc.
1925-30	R. H. Pulleine, M.B., Ch.M.
1930-	Ralph W. Segnit, M.A., B.Sc.

TREASURERS.

1877	J. S. Lloyd.
1877-83	Thomas H. Smeaton.
1883-92	Walter Rutt, C.E.
1892-94	W. L. Cleland, M.B.
1894-09	Walter Rutt, C.E.
1909-20	W. B. Poole.
1920-	B. S. Roach.

EDITORS.

1877-83	Prof. Ralph Tate, F.G.S., F.L.S.
1883-88	Prof. Walter Howchin, F.G.S.
1888-93	Prof. Ralph Tate, F.G.S., F.L.S.
1893-94	Prof. Walter Howchin, F.G.S. Prof. Ralph Tate, F.G.S., F.L.S.
1894-95	Prof. Ralph Tate, F.G.S., F.L.S.
1895-96	Prof. Walter Howchin, F.G.S.
1896-00	Prof. Ralph Tate, F.G.S., F.L.S.
1901-	Prof. Walter Howchin, F.G.S.

REPRESENTATIVE GOVERNORS.

1877-83	[Sir] Charles Todd, C.M.G., F.R.A.S.
1883-87	H. T. Whittell, M.A., M.D., F.R.M.S.
1887-01	Prof. Ralph Tate, F.G.S., F.L.S.
1901-22	Prof. Walter Howchin, F.G.S.
1922-27	Prof. F. Wood Jones, M.B., etc.
1927-29	Prof. T. H. Johnston, M.A., D.Sc.
1929-	Chas. Fenner, D.Sc.

THE SIR JOSEPH VERCO MEDAL.

Awards.

1929	Prof. Walter Howchin, F.G.S.
1930	John McC. Black.
1931	Prof. Sir Douglas Mawson, B.E., D.Sc., F.R.S.

ROYAL SOCIETY OF SOUTH AUSTRALIA
(INCORPORATED).

SUGGESTIONS FOR THE GUIDANCE OF AUTHORS IN THE PREPARATION OF MSS. TO BE SUBMITTED TO THE SOCIETY.

1. The manuscript must be clearly written (especially in the case of scientific and technical terms), and in a form ready to be placed in the hands of the printer. It is a great advantage for MSS. to be typed, double spaced. If the paper be illustrated, the illustrations, maps, etc., must be supplied in a form ready for reproduction. Where reduction is required, detail and lettering must be proportionally enlarged. It may be necessary to return MSS. to authors for typing. In returning proofs to the Editor, the original copy should be included.

2. Uniformity must be preserved throughout in the use of capital letters, italics, abbreviations, punctuation, etc.

3. All generic and specific names must be underlined (denoting italics). Other scientific nomenclature must be in roman. Generic names must begin with a capital letter, and specific and varietal names (even where a proper name is used) must begin with non-capitals, as, for example, *Lovenia forbesi* T. Woods. (An exception to this rule is made in the case of botanical names, where the usage is to retain the capital letter in proper names.)

4. Diphthongs are not allowed; each vowel must be written separately, as, for example, Archaeocyathinae.

5. In the case of original descriptions the following abbreviations should be used: n. gen., n. sp., n. var.

6. Authors and authorities, following a name in roman, must be in italics; following a name in italics, to be in roman; when the species is transferred to another genus the name of the original author to be enclosed in parentheses. (No comma shall appear between the specific name and the name of the author.)

7. The names of Australian States are to be written in full in the text, but in the footnotes and synonymy are to be abbreviated as follow:—Australia, Aust.; New South Wales, N.S.W.; Victoria, Vict.; Tasmania, Tasm.; South Australia, S. Aust.; Western Australia, W. Aust.; Queensland, Qld.; North Australia, N. Aust.; Central Australia, C. Aust.; New Guinea, N. Guin.; New Zealand, N.Z.; Federal Capital Territory, F.C.T. Aust. Western Australia, not West Australia.

8. Symbols or abbreviations used to save trouble in writing, but not intended to appear as such in the printed text, are not allowable.

9. The maximum size of illustrations (maps excepted) to be $7\frac{1}{2}$ inches x 5 inches for plates, and $7\frac{3}{4}$ inches x 5 inches for text figures.

10. Papers submitted to the Society for reading must be lodged at the Society's rooms at least a week before the meeting of Council, which is held on the fourth Thursday in each month, from March to November, inclusive.

See also By-laws, Section VII.—Papers.

Note regarding Abstracts.—The author is requested to supply two brief abstracts of his paper—one for local use, and another, not exceeding 50 words, to be sent to publications which cannot grant more space.

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED).

RULES, AS AMENDED, 1931.

NAME.

1. The Title of the Society is the "Royal Society of South Australia (Incorporated)," hereinafter called the Society.

OBJECTS.

2. The objects of the Society are the promotion and diffusion of scientific knowledge by Meetings for the reading and discussion of Papers, and by such other methods as the Council may from time to time determine.

CONSTITUTION.

3. The Society shall be constituted of persons of either sex who are enrolled as Members. They shall be classed as Fellows, Honorary Fellows, and Associates.

4. Honorary Fellows shall be persons distinguished for their attainments in science, or who have rendered signal service to the Society.

5. Men or women may be Associates; men Associates shall be under the age of 21 years.

6. Associates shall be entitled to become Fellows upon written application to the Council, and payment of the prescribed Subscription payable by Fellows.

7. Honorary Fellows and Associates shall be entitled to all the privileges of Fellows, except that they shall not debate nor vote upon questions dealing with the management of the Society's business.

ELECTION OF MEMBERS.

8. Every Candidate for Membership shall be nominated on the prescribed Form by two Fellows, one of whom shall attest from personal knowledge of the Candidate.

9. The Nomination Form shall be lodged with the Secretary, and shall be submitted to the Council and the Society at their next following Meetings, and the election shall be held at the next Ordinary Meeting.

10. No person shall be eligible for election as an Honorary Fellow unless recommended by the Council.

11. Elections shall be by ballot, one negative in every six or part of six excluding.

12. A Candidate who has been so excluded shall not be eligible to be again nominated within one year of such exclusion.

13. Every person elected shall have immediate notice thereof transmitted to him by the Secretary, on the prescribed Form, stamped with the Seal of the Society, accompanied by a copy of the Rules and By-laws, and shall be enrolled as a Member, after having paid the necessary fees.

14. Within three months of the election of a Member, the Treasurer shall send him a Notice for the Subscription due.

15. At the Meeting of the Council prior to the Annual Meeting of the Society in each year, the Treasurer shall present a list of all Fellows whose Subscriptions are two years or more in arrear.

16. The Secretary shall keep an Official Roll of the Members of the Society, and this, together with the Annual Report of the Council, shall be published in the volume of the Proceedings.

Cessation of Membership.

17. A Member may resign his Membership at any time by notification in writing to the Secretary, and shall thereupon cease to be a Member, but shall not thereby be released from any indebtedness to the Society.

18. If any Fellow or Associate whose Subscriptions shall be more than twelve months in arrear shall fail to pay the same after notification in writing by the Treasurer, the Council may cancel his Membership, and he shall thereupon be notified by the Secretary and cease to be a Member.

Restoration.

19. The Council may, upon such terms as it shall think fit, re-enrol as a Member any person who shall have ceased to be a Member.

Management.

20. The management of the affairs and funds of the Society, and the custody of its property, shall, subject to any By-laws for the time being regulating or prescribing conditions as to the same, be vested in a Council, composed of a President and such other Officers and Members as may be prescribed, who shall be elected and hold office for such periods as may be prescribed.

President.

21. The President shall, if present, preside at all Meetings of the Council or Society. In the absence of the President, his duties shall be carried out by such other Officer or Person denoted or elected in the manner prescribed.

Seal and Sealholder.

22. The Common Seal shall have the name of the Society inscribed upon it, and shall be held by the Secretary, who shall for all legal purposes be deemed to be the Sealholder.

23. The Council shall have the power to use the Seal in the execution of any powers hereby invested in it or otherwise in relation to the affairs or business of the Society. The Seal shall not be used except by the authority of the Council. The Secretary and at least two other Members of the Council shall sign every instrument to which the Seal is affixed, except the notice sent by the Hon. Secretary to a new Member.

Meetings of the Society.

24. A meeting of the Society, to be called the Annual Meeting, shall be held in the month of October in every year, upon a day and at a place to be appointed by the Council.

25. At the Annual Meeting the Council shall submit a Report and a duly audited Financial Statement, and the Meeting shall fill all vacancies among the Officers and the Members of the Council for the ensuing year, and transact any other business of which due notice has been given.

26. The Council may convene an Ordinary Meeting of the Society at any time.

27. The Council may at any time, and shall upon the requisition in writing of at least seven Fellows specifying the purpose for which the Meeting is required, convene a Special Meeting of the Society. The special business for which the Meeting has been convened, and no other, shall be transacted at such Meeting.

28. Seven Fellows shall form a quorum. If at any Meeting a quorum is not present within fifteen minutes after the hour of Meeting, the Meeting shall stand adjourned to a day and time to be appointed by those present not being earlier than seven days. At the Adjourned Meeting the Fellows then present may proceed to business, although fewer than the prescribed quorum may be present.

29. At least three days' notice of every Meeting or Adjourned Meeting, and of the principal items of business to be transacted thereat, shall be given to the Members resident in South Australia by printed notice, or in such manner as may be prescribed.

Auditors.

30. Two persons, not being Members of the Council, shall be elected at the Annual Meeting of the Society in each year to audit the Financial Statement for the following year.

By-laws.

31. The Council may make, repeal, alter, or vary By-laws not inconsistent with these Rules for the effective carrying out of the objects and purposes of the Society; but no such By-law, repeal, alteration, or variation shall be valid unless approved by a majority of the Fellows voting at a Meeting of the Society of which due notice has been given.

Alteration of Rules.

32. The Society may, by a majority of at least-two-thirds of the Fellows present at an Annual Meeting, or at a Special Meeting duly convened for the purpose, make any Rule, or repeal, alter, or vary any existing Rule.

33. In the construction of the Rules of the Society, unless the subject or context requires a different meaning:—

"By-law" shall include regulations under "The Public Library, Museum, and Art Gallery and Institute Act, 1909," or any other Act or Power enabling the Society to make Regulations.

"Prescribed" means prescribed by By-law.

Words denoting the singular number only shall be deemed to include the plural and vice versa. Words denoting the masculine gender shall be deemed to include the feminine.

34. All Rules and By-laws of the Society heretofore in force are hereby repealed.

BY-LAWS.

I.—Nomination Paper for Fellows.

The Nomination Paper referred to in Rules 8 and 9 shall state the full name, distinctions (academic or otherwise), address and occupation of the Candidate, and the class of Membership for which he is nominated. When elected, the date of this election shall be entered upon the Nomination Paper, and signed by the Chairman of the Meeting.

II.—Council.

1. The Council shall consist of twelve (12) Fellows, *viz.*, six Officers and six other Fellows. The Officers shall be a President, two Vice-Presidents, a Treasurer, an Editor, and a Secretary. Any four Fellows of the Council shall form a quorum.

2. At each Annual Meeting all Officers shall retire, and also two other Members of the Council, but all retiring Members shall be eligible for re-election. The Non-official Members to retire shall be those who have been longest in the Council since their last election, or in case of equal tenure, the retirement shall be decided by lot.

3. The vacancies on the Council shall then be filled by election, which shall be by ballot, if so required by any Fellow.

4. The Secretary shall keep a record of attendance of Members at all Meetings of the Council, and present it at the Annual Meeting held in the month of October in each year.

5. If any Member of the Council absents himself for the period of three months from all the Meetings of the Council held during such period, without the permission of the Council, granted by resolution of the Council before the expiration of such period, his position as a Member of the Council shall become vacant.

6. Every casual vacancy in the Council shall be filled at the next Meeting of the Society (by ballot, if demanded by any Fellow).

7. Any matter within the powers of management of the Council may be submitted to the Society in the following manner:—

(a) If referred to the Society by resolution of the Council; or

(b) If Notice of Motion in writing referring to such matter be given to the Secretary by two Fellows.

8. In either case, at the next Meeting of the Society the Fellows who have given Notice, or failing them (or if the matter be referred to the Council), any Fellow may move. The resolution (if any) of the Meeting shall be binding on the Council, *provided, however,* that such resolution shall not prejudice or affect anything authorised and done by or on behalf of the Council relating to such matter, if the same be done prior to the receipt of Notice of Motion by the Secretary.

III.—Subscriptions.

1. The Annual Subscription of a Fellow shall be one guinea.

2. A Fellow may at any time compound for future Annual Subscriptions by the payment of fifteen guineas, and shall be called a Life Fellow.

3. Associates shall subscribe half-a-guinea per annum.

4. All Subscriptions shall be payable in advance immediately after the Annual Meeting, or on receipt of Notice of Membership, as the case may be, to the Treasurer, who shall give a receipt on a printed form for the sum received.

5. The financial year shall extend from October 1 to September 30. Membership for the whole or any part of any financial year shall entail the payment of the Subscription for that year, and shall entitle the Member to the receipt of any publication issued free to Members during that year.

IV.—Endowment Fund.

1. The Endowment Fund, and such money as may be added to it from time to time, shall remain intact unless decided otherwise by a majority consisting of at least five-sixths of Fellows whose Subscriptions are fully paid, and who have met at a Special Meeting duly convened for that purpose.

2. Securities, bonds, stocks, etc., belonging to the Society shall be deposited in a Bank, or other place selected by the Society, and shall be made available for inspection only on the written authority of the President, or, in his absence, a Vice-President, who shall give a written Order to the Manager of the Bank, or other responsible Officer who has the securities, etc., in custody.

V.—Library Committee.

1. The Library Committee shall consist of the President, two Vice-Presidents, Secretary, Editor, and one other Member elected by the Council, of whom three shall constitute a quorum. The Librarian to act as the Secretary.

2. The Committee shall meet at such times as may be determined, and after due Notice shall have been given.

VI.—Meetings of the Society.

1. Meetings shall be held on the second Thursday in each month, from April to November, at 8 p.m., in the Society's Rooms, unless the Council shall otherwise decide. Each Meeting shall be convened by Circular posted not less than three days prior to the date of the Meeting to the last known address of each Member resident in the State. The Circular shall state the Subjects to be brought before the Society, the Names of Candidates for Membership, and any Notices of Motion.

2. In the absence of the President, one of the Vice-Presidents shall take the chair; and in the event of their absence, the Members present shall elect one of their number as Chairman.

3. The business shall be transacted in the following Order, unless it be specially decided otherwise by the Meeting:—

- *(a)* Reading and confirmation of the Minutes of last Meeting.
- *(b)* Correspondence.
- *(c)* Election of Members.
- *(d)* Nomination of Candidates for Membership.
- *(e)* Consideration of Motions of which Notice has been given.
- *(f)* Reading of Notices of Motions for subsequent Meetings.
- *(g)* Consideration of any special matters which Members may desire to bring forward, subject to the approval of the Chairman obtained before the commencement of the Meeting.
- *(h)* Any other business brought forward by the Council.
- *(i)* Papers or Discussions notified on the Circular.
- *(k)* Exhibits.

VII.—Papers.

1. No Paper which has not been previously approved by the Council shall be brought before the Society.

2. Every Paper intended for presentation before the Society shall be deposited with the Secretary, or at the Rooms of the Society, not later than the third Thursday of any month, from March to November.

3. The Council shall, at its next Meeting, consider whether such Paper will be read.

4. At the Council Meeting subsequent to the reading of the Paper, the question of publication shall be considered.

5. If the Council decides to publish the Paper, in whole or in part, it and all copyrights thereof shall become the property of the Society, such copyrights to include all plates, maps, diagrams, and photographs reproduced in illustrating the Paper. All manuscripts and original illustrations must be returned to the Editor with the corrected proofs.

6. All matter used in illustration of Papers (whether photographs, prints, negatives, or drawings) remains the property of the Authors. Blocks used for illustrations may be obtained on application to the Librarian. Any subsequent publication of such material shall be by permission of the Council in writing, and the source of such copyright material shall be duly acknowledged. The illustrations shall be returned to the Secretary by the Printer on publication of the volume and shall be kept in safe custody for one year, unless previously claimed by the Author. After the expiration of one year they may be disposed of as the Council shall direct.

7. If the Council decides not to publish a Paper, either in whole or in part, it shall be returned to the Author, if he so desires.

8. All Papers and other contributions to be published by the Society shall be subjected to editing by the Editor.

9. The Author of any Paper published by the Society shall be entitled to receive free of cost 25 copies, and to obtain additional copies (not exceeding 75, unless the Council shall determine otherwise) upon paying the extra cost thereof. Every such copy shall include a statement that it is taken from the publications of the Society.

10. All contributions and excerpts intended for publication by the Society shall be typed (double spaced) or clearly written on one side of the paper, and shall be in accordance with the "Suggestions for the Guidance of Authors" published in the last Volume of the Proceedings of the Society.

11. A proof shall be submitted (if possible) to the Author, who shall be allowed to make any slight amendments without cost, but if the corrections are deemed by the Council to be excessive, they must be paid for by the Author.

12. In order to secure correct reports in the Press and Science Abstracts, each Paper or other contribution laid before the Society must be accompanied by three short synopsis, one of which must not exceed 50 words.

VIII.—Sections.

1. With the consent of the Council, Sections may be formed in connection with the Society for the special study of particular branches of Natural or Applied Science.

2. Such Sections shall consist of :—
   (a) Members of the Society who join the Section and pay an Annual Subscription to the Section.
   (b) Other persons who have been duly elected to the Section and who pay its Annual Subscription.

3. A Member of the Society who joins any Section shall not be required to pay an Entrance-fee, and the Annual Subscription paid by him shall not exceed one-half of that paid by Non-members of the Society.

4. Each Section shall elect its own Committee of Management.

5. The President and Vice-Presidents of the Society, for the time being, shall be Ex-officio Members of the Committee of Management of all Sections.

6. The Rules and Regulations for the management of Sections shall not have effect until they have been formally approved by the Council of the Society.

7. Subscribers to the Sections shall have access to the Library of the Society, subject to such conditions as may be imposed by the Council.

8. The Committee of Management of each Section shall, on or before September 15 of each year, furnish to the Council of the Society an Annual Report of the Procedings of the Section and its Balance-sheet.

9. Sections, and approved Societies, shall be allowed the use of the Society's Rooms at such times as may be approved by the Council, on payment of rental at the rate of thirty shillings per annum.

10. Grants of money out of the general funds of the Society may be made by the Council to any Section.

IX.—Regulations for the Election of a Member of the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia, pursuant to "The Public Library, Museum, and Art Gallery and Institute Act, 1909."

1. At a Meeting in October the Council shall elect one Member of the Board; such election shall be by ballot, if so required by a Member.

2. No person shall be elected unless he is at the time of his election a Member of the Society, nor shall he continue to hold office as such Member of the Board if he ceased to be a Member of the Society.

3. The elected Member shall hold office until the election of his successor, and shall then retire, but may be re-elected.

4. Every casual vacancy shall be filled at the next Meeting of the Society (by ballot if demanded by any Fellow).

5. The result of each election shall be certified to His Excellency the Governor under the hand of the President.

6. The elected Member shall be deemed to be the representative of the Society upon the said Board, and shall (subject to his duties to the Board) report to the Council all matters concerning the Society which may be dealt with by the Board, and shall make such representations on behalf of the Society as the Society or the Council may from time to time direct.

GENERAL INDEX.

[Generic and specific names in italics indicate that the forms described are new to science.]

PLATES 1 to VIII.

Fig. 1.

Fig. 2.

Photo. by H. H. Finlayson.

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Photo by H. H. Finlayson.

Gillingham & Co. Ltd., Printers, Adelaide

Fig. 1

Fig. 2

Fig. 3

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Photo. by W. Howchin

Fig. 1. Ancient Consolidated River Remains exposed by erosion in the Walloway Creek.

Photo. by R. F. Stevens

Fig. 2. Ancient Consolidated River Remains in the neighbourhood of Caltowie. A higher line of exposure can be seen in the background.

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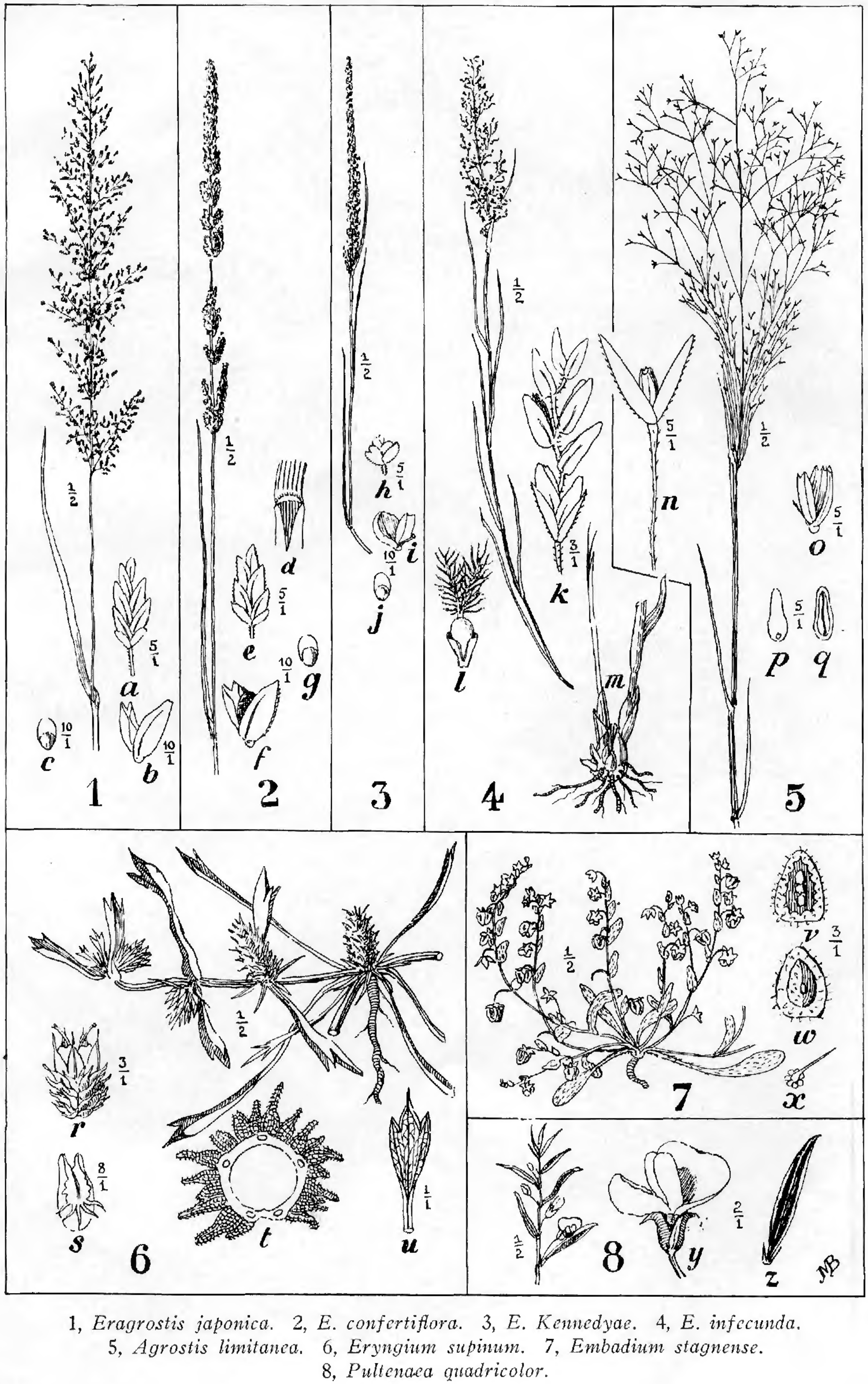
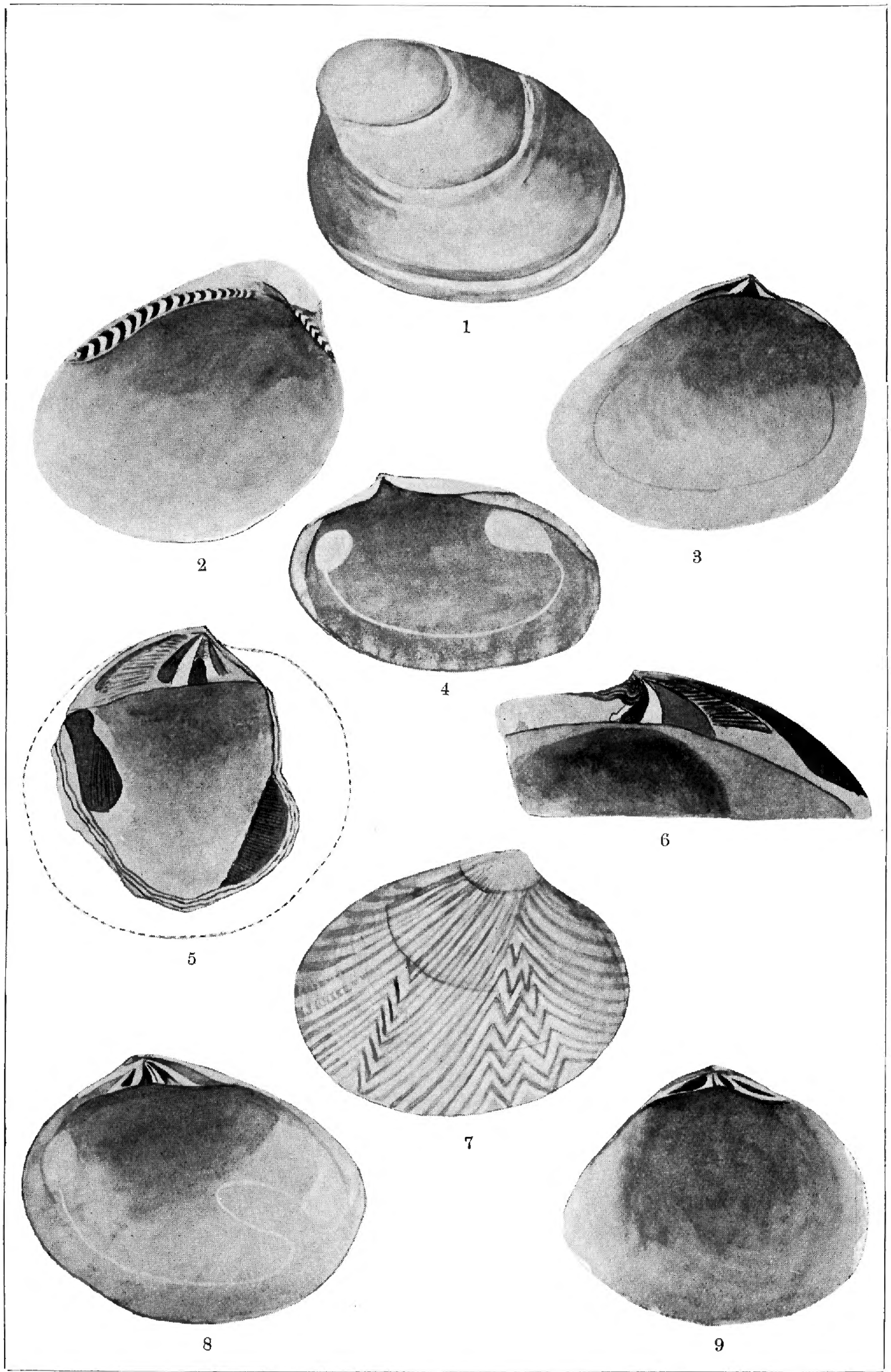


1, *Eragrostis japonica*. 2, *E. confertiflora*. 3, *E. Kennedyae*. 4, *E. infecunda*. 5, *Agrostis limitanea*. 6, *Eryngium supinum*. 7, *Embadium stagnense*. 8, *Pultenaea quadricolor*.



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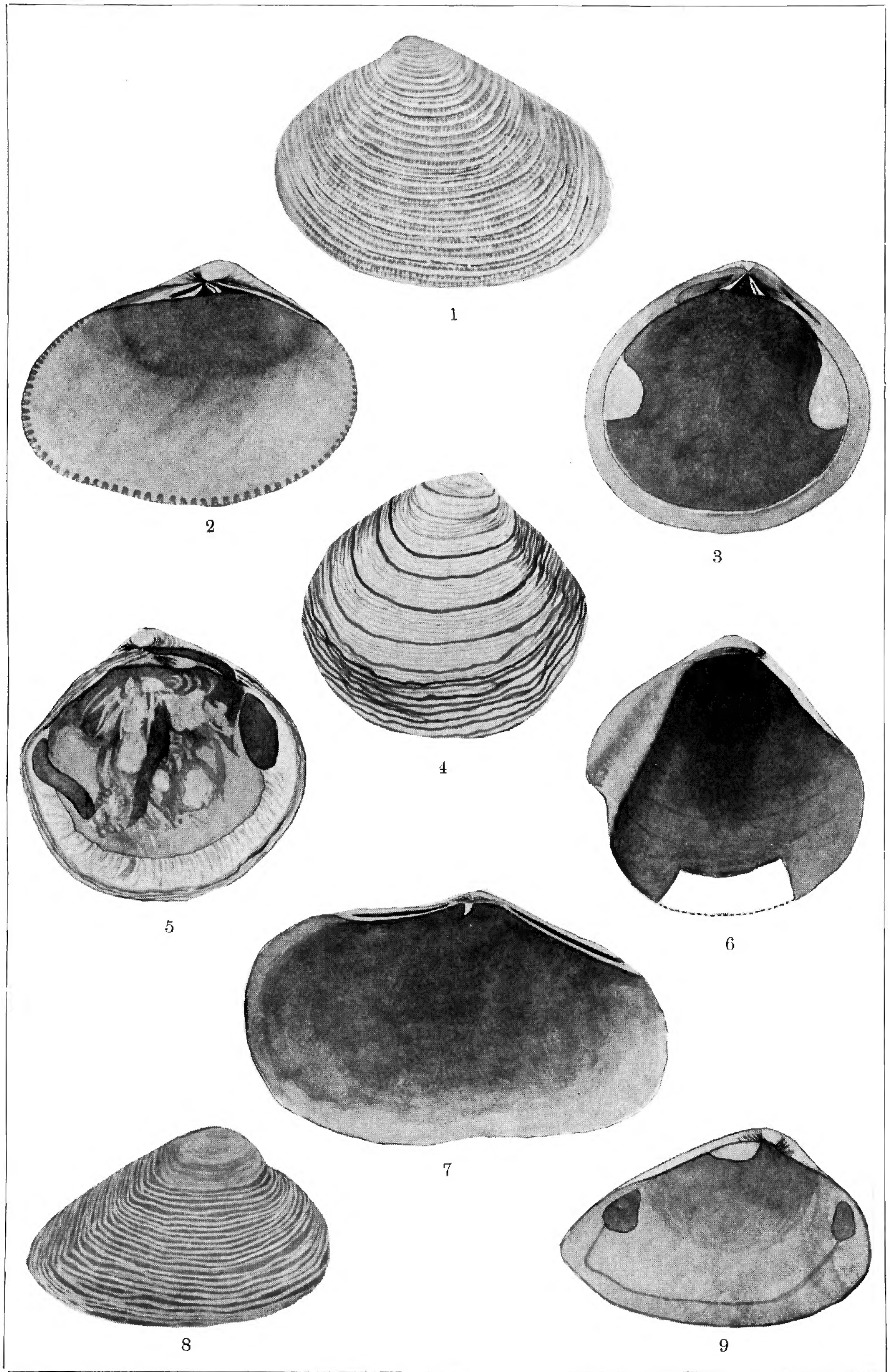

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